EPA/ROD/R04-02/028
2002

EPA Superfund
Record of Decision:

CALHOUN PARK AREA
EPA ID: SCD987581337
OU 02
CHARLESTON, SC
09/24/2002

RECORD OF DECISION
REMEDIAL ALTERNATIVE SELECTION

CALHOUN PARK AREA SITE
OPERABLE UNIT 2
CHARLESTON, CHARLESTON COUNTY
SOUTH CAROLINA

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Calhoun Park Area Site
Operable Unit 2 – Intermediate Groundwater, Sediment and Surface Water
City of Charleston, Charleston County, South Carolina

STATEMENT OF BASIS AND PURPOSE

This decision document presents the Selected Remedy for the Calhoun Park Area Site (CPA Site) in Charleston, South Carolina, which was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record file for this site.

The State of South Carolina, acting as a support agency, concurs with the Selected Remedy.

ASSESSMENT OF THE SITE

Existing impacts to intermediate zone groundwater and sediments along the right descending bank of the Cooper River, consisting mainly of polynuclear aromatic hydrocarbons (PAHs) and benzene, toluene, ethylbenzene and xylenes (BTEX), are attributable to the previous manufactured gas plant (MGP) operations at the CPA Site. The response action selected in this Record of Decision is necessary to protect public health or welfare or the environment from actual or potential releases of constituents into the environment.

DESCRIPTION OF SELECTED REMEDY

This remedial action for Operable Unit 2 (OU#2) at the CPA site addresses impacts to the intermediate groundwater zone at the CPA Site, including the presence of dense non-aqueous phase liquids (DNAPL) which are a source material for dissolved phase constituents. Sediments and surface water are also addressed, although it has been determined that no additional action regarding surface water is necessary to protect public health or the environment because of previous response action. DNAPL within the intermediate groundwater zone constitutes the principal threat within OU#2. PAH constituents in sediments have also been identified as a concern.

A Record of Decision (ROD) for Operable Unit 1 (OU#1) at the CPA Site was issued by EPA in September 1998. The OU#1 ROD addressed DNAPL source areas, shallow groundwater impacts, and impacted soil. The impacted soil removal action has been completed, along with significant DNAPL removal and initial shallow groundwater treatment activities. Remedial actions to address remaining shallow DNAPL source areas and shallow groundwater impacts will continue concurrent with implementation of the Selected Remedy for OU#2. For those constituents that are also a concern in the intermediate groundwater zone, the performance standards will be similar to those established for shallow groundwater. In addition, a performance standard of 10 mg/L has been established for xylenes (total). The performance standards for sediments are based on EPA’s recently published equilibrium partitioning sediment guideline toxicity units (ESGTUs) for PAHs.

The Selected Remedy includes the following major components:

- DNAPL removal to the extent practicable will be accomplished using either stationary or portable pumping equipment. A five-year DNAPL recovery period has been estimated. The recovered DNAPL will be transported off-site for reuse or treatment and disposal.

- In situ treatment of impacted groundwater within the intermediate zone will be conducted. The in situ treatment may involve increasing dissolved oxygen concentrations to stimulate microbial activity and biodegradation, or the direct destruction of dissolved constituents via chemical oxidation. Selection of the most appropriate oxidant will be determined during the remedial design phase, as well as the appropriate areas for injection and the number and anticipated frequency of applications.

- Evaluation of containment measures if DNAPL removal and institutional measures do not mitigate potential migration of dissolved phase constituents.

- Groundwater monitoring will be conducted within the impacted portion of the intermediate zone and at sentinel well locations. Based on the in situ treatment benefits of the Selected Remedy, the total duration of groundwater monitoring is projected at 12 years.

- Restrictions to future uses of intermediate groundwater on SCE&G property at the CPA Site will be imposed through a deed notification. Although exposure to intermediate groundwater does not currently exist and is not expected in the future, the use of institutional controls by SCE& G assures adequate protection of human health.

- Monitoring of existing sand blankets at the perimeter of existing structures and along the west bank of the Cooper River will be conducted.

- Maintenance of the existing sand blankets will be performed, if required. The sand blanket may be augmented depending upon supplemental total organic carbon and PAH data collected during the remedial design.

STATUTORY DETERMINATIONS

The Selected Remedy is protective of human health and the environment, will comply with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. Because uncertainty exists regarding the ability of the Selected Remedy to achieve the groundwater target clean-up goals due to the presence of residual DNAPL in the intermediate zone, a phased approach has been selected. The phased approach consists of removal or treatment of DNAPL to the maximum extent practicable, followed by containment of potentially non-restorable source areas, and restoration of the aqueous constituent plumes.

This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility or volume of hazardous constituents as a principal element through treatment). DNAPL within the intermediate groundwater zone constitutes the principal threat within OU#2. PAH constituents in sediments have been identified as of concern, due to potential exposure to benthic organisms. However, based on the limited extent of sediments impacted by PAHs, the presence of the existing sand blankets, and the calculated potential ecological risks, impacted sediments are considered a low-level threat and exposure control via the sand blankets provides adequate protection.

Because this remedy will result in constituents remaining on-site above levels that allow unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record file for this site.

- Chemicals of concern and their respective concentrations (Section 5.2).
- Baseline risk represented by the chemicals of concern (Section 7.0).
- Clean-up levels established for chemicals of concern and the basis for these levels (Section 8.0).
- How source materials constituting principal threats are addressed (Section 11.0).
- Current and reasonably anticipated future land use assumptions, and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD (Section 6.0).
- Potential land and groundwater use that will be available at the site as a result of the Selected Remedy (Section 12.0).
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Section 12.0).
- Key factors that led to selecting the remedy (i.e., how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, with criteria key to the decision highlighted) (Sections 10.0, 12.0 and 13.0).

AUTHORIZING SIGNATURE

Richard D. Green, Director
Waste Management Division

24 SEP 02
Date

Table of Contents

Part I: Declaration

Part II: Decision Summary

1.0 SITE NAME, LOCATION AND BRIEF DESCRIPTION 1

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES 3
2.1 Previous Site Operations 3
2.2 Previous Investigations 3
2.3 Previous Response Actions 5
2.4 Enforcement Activities 7

3.0 COMMUNITY PARTICIPATION 7

4.0 SCOPE AND ROLE OF OPERABLE UNIT OR RESPONSE ACTION 7

5.0 SITE CHARACTERISTICS 8
5.1 Physical Characteristics 8
5.1.1 Intermediate Zone Stratigraphy 8
5.1.2 Intermediate Zone Aquifer Characteristics 9
5.1.3 Surface Water Hydrology and Sediments 10
5.2 Nature and Extent of Constituent Impacts 11
5.2.1 Intermediate Groundwater 11
5.2.3 Surface Water 13
5.3 Conceptual Site Model 14
5.3.1 Physical Setting 14
5.3.2 Geology and Hydrogeology 15
5.3.3 Nature and Extent of Constituent Impacts 16
5.3.4 Fate and Transport of Constituents of Interest 18
5.3.5 Pathways and Receptors 19

6.0 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES 19

7.0 SUMMARY OF SITE RISKS.. 20
7.1 Human Health Baseline Risk Assessment 20
7.2 Ecological Risk Assessment 21

8.0 REMEDIAL ACTION OBJECTIVES 22
8.1 Intermediate Groundwater 22
8.2 Sediments 22

9.0 DESCRIPTION OF ALTERNATIVES 23
9.1 Intermediate Groundwater Alternatives 23
9.1.3 Alternative 3 – Institutional Controls, DNAPL Removal and Monitored Natural Attenuation................................ 25
9.1.4 Alternative 4 – Institutional Controls, DNAPL Removal and In Situ Treatment 26
9.1.5 Alternative 5 – Institutional Controls, DNAPL Removal, Extraction Wells, Separation and POTW Discharge 26
9.2 Sediments 27
9.2.1 Alternative 1 – No Action 27
9.2.2 Alternative 2 – Utilization of Existing Sand Blanket with Monitoring and Maintenance 28
9.2.3 Alternative 3 – Excavation, Off-Site Thermal Desorption and Backfill with Monitoring..................................... 28

10.0 COMPARATIVE ANALYSIS OF ALTERNATIVES 29
10.1 Intermediate Groundwater Alternatives 29
10.1.1 Overall Protection of Human Health and the Environment 30
10.1.2 Compliance With ARARs 30
10.1.3 Short-Term Effectiveness 30
10.1.4 Long-Term Effectiveness and Permanence 31
10.1.5 Reduction of Toxicity, Mobility or Volume Through Treatment .. 31
10.1.6 Implementability 31
10.1.7 Cost 32
10.1.8 State Acceptance 32
10.1.9 Community Acceptance 32
10.1.10 Comparison Summary 33
10. 2 Sediments 33
10.2.1 Overall Protection of Human Health and the Environment 34
10.2.2 Compliance With ARARs 34
10.2.3 Short-Term Effectiveness 34
10.2.4 Long-Term Effectiveness and Permanence 34
10.2.5 Reduction of Toxicity, Mobility or Volume Through Treatment .. 34
10.2.6 Implementability 35
10.2.7 Cost 35
10.2.8 State Acceptance 35
10.2.9 Community Acceptance 35
10.2.10 Comparison Summary 36

11.0 PRINCIPAL THREAT WASTE 36

12.0 SELECTED REMEDY 37
12.1 Rationale for the Selected Remedy 37
12.2 Description of the Selected Remedy 38
12.2.1 Intermediate Groundwater 38
12.2.2 Sediments 39
12.3 Summary of Estimated Remedy Costs 40
12.4 Expected Outcomes of Selected Remedy 41

13.0 STATUTORY DETERMINATIONS 41
13.1 Protection of Human Health and the Environment 42
13.2 Compliance with Applicable or Relevant and Appropriate Requirements .. 42
13.3 Cost-Effectiveness 43
13.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable (MEP) 43
13.5 Preference for Treatment as a Principal Element 44
13.6 Five-Year Review Requirements 45

14.0 DOCUMENTATION OF SIGNIFICANT CHANGES 45

15.0 REFERENCES 46

Part III: Responsiveness Summary

1.0 SITE NAME, LOCATION AND BRIEF DESCRIPTION

The Calhoun Park Area Site (CPA Site) is located in the City of Charleston, South Carolina on the eastern side of the peninsula. The CPA Site (EPA ID #SCD987581337) includes the South Carolina Electric & Gas Company (SCE&G) Charlotte Street electrical substation, the former Calhoun Park, and portions of the former Ansonborough Homes property, Ludens Marine, and the National Park Service property (Figure 1). The U. S. Environmental Protection Agency (EPA) is the lead agency for the site, and the South Carolina Department of Health and Environmental Control (SCDHEC) is the support agency. SCE&G is responsible for the site investigation, and remediation costs. EPA is responsible for oversight of SCE&G site investigations and site remedial actions.

The current use of the SCE&G property is an electrical substation that contains numerous electrical transformers and associated controls, and supplies electricity to the majority of the Charleston peninsula and other areas within the region. Formerly, the SCE&G property was a manufactured gas plant (MGP). Calhoun Park, a former public recreational park, is now the site of a 1,100-car parking garage operated by the City of Charleston. The Ansonborough Homes portion of the CPA Site is currently occupied by soccer fields on the southern portion and additional development is expected for the remaining northern area. The former Ansonborough Homes housing project was razed during 1996 and 1997 by the City of Charleston.

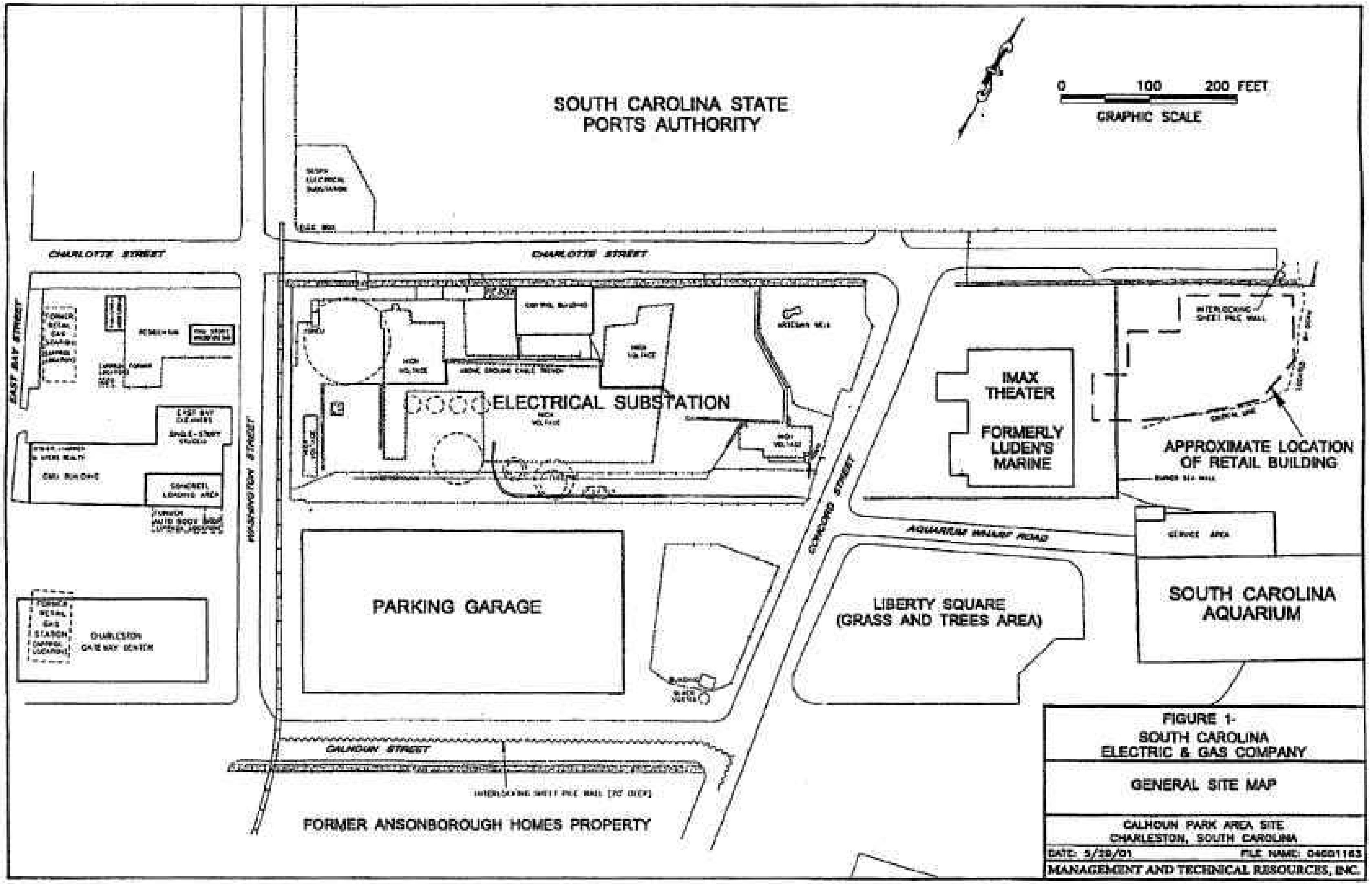
Properties adjacent to the electrical substation have been developed for commercial use. Immediately to the north of the electrical substation, directly across Charlotte Street, the South Carolina State Ports Authority (Ports Authority) operates an inter-modal transportation and storage facility. Bounding the site to the west along Washington Street are rail lines of the Seaboard Railroad. A mixture of light industrial, business and residential uses are present to the west of Washington Street. The Cooper River is approximately 500 feet east of the CPA Site. East of the electrical substation is a former marine supply and boat repair yard owned by J.J.W. Luden’s Marine Supply (Luden’s). The Luden’s property has since been redeveloped as an IMAX theatre, and a new retail/office building has been constructed in the eastern portion of the property. A large area located south of Luden’s and east of Calhoun Park is subdivided into three separate properties. The largest parcel is the approximate 3.8 acres of National Park Service (NPS) property, which is currently a visitor’s center and tour boat docking facility to shuttle tourists to Fort Sumter. The second parcel is an approximate 0.82-acre area owned by the NPS and leased to the City of Charleston for the South Carolina Marine Sciences Museum (City Aquarium), which opened in May 2000. The third parcel is an approximate 0.78-acre parcel formerly owned by George C. Campsen (and presently owned by the NPS) and is a proposed site for a future park area. The Dockside Condominium complex is located to the south of the NPS area and east of the former Ansonborough Homes area.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 Previous Site Operations

The MGP formerly operated on the northern portion of the CPA Site from approximately 1855 until 1957 by predecessor companies of SCE&G. The physical layout of the former MGP is predominantly situated under the active electrical substation. The MGP was originally operated as a coal-gasification plant but was later converted to a water-gas plant in 1910. In addition, a coal tar and pine pitch refining plant and paint and chemical manufacturer operated on Calhoun Park during the late 1800’s.

The CPA Site and properties to the east historically consisted of mud flats and marshlands or waterfront, and did not support building structures. Historically, wharves lined the west bank of the Cooper River. Starting in approximately 1700, the area between Washington Street and the current western boundary of the Cooper River was created by the placement of fill. The National Park Service (NPS) property was filled during 1940 to 1942 with dredged river material from an unknown source for use by the U. S. Navy. Following World



SOUTH CAROLINA STATE PORTS AUTHORITY
0 100 200 FEET
GRAPHIC SCALE
CHARLOTTE STREET
CHARLOTTE STREET
EAST BAY STREET
WASHINGTON STREET
ELECTRICAL SUBSTATION
CONCORD STREET
IMAX THEATER
FORMERLY LUDEN'S MARINE
APPROXIMATE LOCATION OF RETAIL BUILDING
AQUARIUM WHARF ROAD
PARKING GARAGE
LIBERTY SQUARE (GRASS AND TREES AREA)
SOUTH CAROLINA AQUARIUM
CALHOUN STREET
FORMER ANSONBOROUGH HOMES PROPERTY
FIGURE 1-
SOUTH CAROLINA ELECTRIC & GAS COMPANY
GENERAL SITE MAP
CALHOUN PARK AREA SITE
CHARLESTON, SOUTH CAROLINA
DATE: 5/29/01
FILE NAME: 04001163
MANAGEMENT AND TECHNICAL RESOURCES, INC.

War II, the NPS, Deyton and Dockside Condominiums properties were primarily used for ship maintenance and dry-dock repairs.

The Luden’s building was originally constructed in 1910 as a steam generation plant associated with the water-gas operation of the MGP. The original coal-gasification plant extended eastward to the west portion of the Luden’s property, and coal was off-loaded from barges onto a tram extending to the Cooper River. Concord Street was extended from Calhoun Street to Charlotte Street and the three-story building on the Luden’s property was constructed on man- made land surrounded to the south and east by a sea-wall. After MGP-associated operations ceased, the Luden’s property was primarily utilized as a marine supply and recreational boat repair facility. The original 1910 building structure remains and has been converted into the IMAX theater and retail complex.

2.2 Previous Investigations

Intermediate Groundwater

Information regarding the intermediate groundwater zone at the CPA Site was obtained during development of the Remedial Investigation/Feasibility Study (RI/FS) Work Plan (Chester Environmental, September 1993), and during implementation of the Remedial Investigation (RI) in 1993 and 1994. The information is summarized in the RI Report (Fluor Daniel GTI, September 1996). Based on that information, EPA determined that additional characterization of the intermediate zone was required, and that a separate Record of Decision (ROD) would be issued to address the intermediate groundwater.

Additional investigative activities within the intermediate zone that have been conducted by SCE&G subsequent to completion of the initial RI include the following:

- Groundwater sampling and analyses conducted by Fluor Daniel GTI in 1998;
- Investigation of the Luden’s property conducted by IT Corporation in 1999;
- Additional characterization of the intermediate groundwater zone conducted by Godfrey and Associates in May 2000;
- Confirmational groundwater monitoring activities conducted by MTR in August 2000;
- Comprehensive intermediate groundwater monitoring conducted by MTR in November 2000;
- Supplemental intermediate groundwater assessment conducted by Ish Inc. in November 2000; and
- Remedial pre-design characterization activities conducted by MTR and Ish Inc. from June through December 2001.

The additional information obtained during implementation of these activities is summarized in the Remedial Investigation/Focused Feasibility Study for the Intermediate Groundwater Zone (MTR, June 2001) and the Intermediate Groundwater Interim Status Report (MTR, February 2002). The information has been utilized to develop an updated overall description of the physical characteristics and the nature and extent of constituent impacts within the intermediate zone.

Sediment and Surface Water

Information regarding sediments and surface water at the CPA Site was obtained during development of the RI/FS Work Plan and implementation of the RI in 1993 and 1994. The information is summarized in the RI Report (Fluor Daniel GTI, September 1996) and initial ROD.

The nature and extent of potential impacts to the benthic community within the Cooper River was determined during the initial RI by analyses of sediment samples. The analytical results were compared to relevant ecological screening criteria, and indicated that the primary constituents of concern were polynuclear aromatic hydrocarbons (PAHs). Sediment samples with the highest PAH concentrations were clustered in two primary areas: the former Calhoun Street drain outfall and the area adjacent to NPS property. An assessment of benthic macroinvertabrates was also performed on a portion of the Cooper River adjacent to the site. The findings at the close of the initial RI/FS indicated that there were no significant differences between on-site and off-site stations.

Surface water samples analyzed during the initial RI were collected from the Cooper River, as well as flood water surrounding the Ansonborough Homes property and storm water outfalls. The analytical results were compared to EPA ambient water quality criteria (AWQC), which indicated that the detected constituents were not above the AWQC standards.

Coal tar seeps appeared at the end of Charlotte Street, adjacent to the Cooper River shoreline, following completion of the RI Report and prior to issuance of the original ROD for the CPA Site. Because the seeps represented a new source for potential sediment and surface water impacts, the original ROD proposed that additional investigative activities be conducted and a second ROD subsequently issued, to address sediments and surface water.

Additional sediment and surface water investigative activities conducted subsequent to completion of the initial RI include the following:

- Additional sediment sampling and analyses conducted by Fluor Daniel GTI in June 1997; and

- Sediment and surface water characterization conducted by Godfrey and Associates in November and December 1999.

The additional information obtained during implementation of these activities is summarized in the RI Addendum Report – Additional Sediment Sampling (Fluor Daniel GTI, October 1997) and the Interim Report on Additional Sediment and Surface-Water Characterization (Godfrey and Associates, February 2000). The information has been utilized to develop an updated understanding of the nature and extent of constituent impacts to sediment and surface water associated with the CPA Site, and to prepare an updated ecological risk assessment (Godfrey and Associates, April 2002).

2.3 Previous Response Actions

Significant remedial efforts have been completed to date to address the environmental impacts from past MGP operations at the CPA Site, and those actions are summarized below.

Sediment Containment

The site area has been subject to significant construction and redevelopment efforts. Concerns over the planned construction of the City Aquarium on NPS property led to development of a containment plan to minimize potential discharges of constituents from the construction activities. The containment system, installed by the aquarium contractor, consisted of a sand blanket to minimize resuspension of impacted sediments, a timber lagging wall to limit discharge of particulates to the subtidal area, and a silt curtain to contain sand from the sand blanket that might be disturbed during construction. Following completion of the construction activities, a Demonstration Program Report (Killiam Associates, May 1996) was generated which documented the effectiveness of the containment system.

A second sediment containment system was later installed by the NPS on another portion of the property in support of construction of the tour boat facility. This second system, located south of the aquarium containment system, was designed to address impacted sediments present where the former Calhoun Street drain discharged to the Cooper River.

Calhoun Street Drain Project

During the RI, the City of Charleston began work to replace an old storm drain constructed of brick that paralleled the site along Calhoun Street. A portion of the site's shallow groundwater infiltrated the drain through deteriorating mortar joints and discharged to the Cooper River. To facilitate construction and prevent the gravel bed under the replacement drain from acting in a similar manner, sheet piling was installed between the impacted shallow groundwater and the new storm drain. A plan was also established to monitor the effectiveness of the sheet piling in preventing future infiltration of impacted groundwater.

Soil Removal and Seep Mitigation

Remediation efforts at the CPA Site have included removal of impacted unsaturated zone soil (0 to 3 feet below ground surface) in accordance with an EPA time-critical removal order. The soil cleanup goals were based on protection of future resident and construction worker, as outlined in the 1998 ROD. The soil removal was completed in 1998 prior to construction of the parking garage, and was conducted primarily on the former Calhoun Park portion of the site. Areas on National Park Service (NPS) property, Luden's property, and the eastern portion of the electrical substation were also included. No soil removal was necessary for the soils at the Ansonborough Homes property.

In 1999, remediation efforts focused on seep mitigation activities at the end of Charlotte Street. Those activities involved removal of the old sea wall, removal of approximately 300 tons of impacted sediment, installation of a sheet pile wall perpendicular to Charlotte Street with three DNAPL monitoring/recovery wells on the land side of the wall, and improvements to the storm drain. Additional source removal excavations at the eastern portion of the electrical substation were also completed in 1999 following the seep mitigation effort.

Source Removal In DNAPL Occurrence Areas

Following the soil removal action and seep mitigation, remediation efforts focused on source delineation and removal at six DNAPL occurrence areas above the upper clay in the shallow groundwater zone. The DNAPL removal via excavation activities were completed for accessible areas of the site between 1999 and 2002.

In addition to the DNAPL removal via excavation activities, SCE&G is addressing accumulations of DNAPL in shallow and intermediate monitoring wells, recovery wells and piezometers via a manual recovery program. These excavation activities began in 1999. The additional DNAPL removal activities will continue, particularly from the DNAPL recovery trenches installed at the perimeter of excavation areas within the electrical substation.

Shallow Groundwater Remediation

A phytoremediation system consisting of hybrid poplar trees has been installed in the area between the active electrical substation and parking garage busway to address dissolved phase constituents in shallow groundwater. Trees were initially planted in November 1998, by SCE&G ~~the United States Geological Society (USGS)~~ and supplemented with a planting in the eastern portion of the area by the USGS in March 2000.

Also, Oxygen Release Compound (ORC) has been utilized to address shallow groundwater constituent plumes at the CPA Site. The use of ORC during remediation activities to date has
included the following:

- Excavated source areas were backfilled with ORC-enhanced material at the Luden's property (Area 5) in early 2000;

- ORC injection was conducted along Concord and Calhoun Streets in Areas 2, 3 and 4 in

- October 2000, prior to the DNAPL excavation that was subsequently conducted in those areas;

- ORC socks were placed in wells MRW-01 and MW-12 at the NPS property (Area 6) in March 2001, and ORC injection was conducted at Area 6 in June 2001; and

- Excavated source areas were backfilled with ORC-enhanced material in early 2002 along the eastern perimeter of the excavations in Area 3-South and Area 4, and along the southern edge of the Area 4 excavation.

The application of ORC within backfill material (in Areas 3- South, 4 and 5) was intended to enhance the natural aerobic biodegradation of dissolved phase constituents that may remain in shallow groundwater subsequent to the source removal. Preliminary data on concentrations of constituents within the shallow groundwater indicate that these efforts appear to be producing a beneficial effect upon remediating the site.

2.4 Enforcement Activities

Initial RI/FS activities were conducted pursuant to an Administrative Order on Consent (AOC) between EPA and three respondents: SCE&G, the City of Charleston, and the Housing Authority of the City of Charleston (EPA Docket No. 92-39-C, effective January 22, 1993). As discussed below in Section 4.0, EPA issued a ROD for the CPA Site in September 1998. Soil and shallow groundwater were addressed in that ROD as Operable Unit 1 (OU#1).

A second AOC, effective May 13, 1998, was signed by EPA and SCE&G to facilitate the delineation, excavation and disposal of impacted soils in advance of construction and redevelopment activities at the site. Additionally, mitigation of coal tar seeps located at the end of Charlotte Street was addressed in the May 1998 AOC.

In January 1999, EPA issued a Unilateral Administrative Order (UAO) to SCE&G requiring implementation of the ROD for OU#1. Since March 1999, EPA and SCE&G have resolved technical disagreements regarding the ROD for OU#1. Concurrently, SCE&G has implemented significant DNAPL removal activities for OU#1 within the shallow zone and conducted additional assessment activities for OU#2. If necessary, an Explanation of Significant Differences (ESD) will be prepared for OU#1 to resolve any significant discrepancies between the ROD and final remediation plans.

3.0 COMMUNITY PARTICIPATION

All information including technical reports and Feasibility Studies used in support of the proposed plan for the Calhoun Park Site were made available to the public on July 8, 2002. They can be found in the Administrative Record file and the information repository maintained at the EPA docket room and at the Charleston County Main Library. The notice of the availability of this information was published in the Charleston Post and Courier on July 6, 2002. A public comment period was held from July 8, 2002 to August 8, 2002. No extension of the comment period was requested. Additionally a public meeting was held on July 11, 2002 to present the proposed plan to the community. During this meeting, representatives from EPA and the South Carolina Department of Health & Environmental Control answered questions about problems at the site and the remedial alternatives. EPA’s response to comments received during this period is included in the Responsiveness Summary, which is part of this Record of Decision.

4.0 SCOPE AND ROLE OF OPERABLE UNIT OR RESPONSE ACTION

As with many Superfund sites, the problems at the CPA Site are complex. As a result, EPA has organized the work into two operable units (OUs):

- Operable Unit 1: Impacted soil, shallow groundwater and DNAPL source areas

- Operable Unit 2: Intermediate groundwater, surface water and sediments

EPA has already selected the remedy for Operable Unit 1 (OU#1) in a ROD issued on September 30, 1998. The remedy for OU# 1 was selected under the authority of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and was consistent with the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The impacted soil removal action has been completed, along with significant DNAPL removal and initial shallow groundwater treatment activities. Remedial actions to address remaining shallow DNAPL source areas and shallow groundwater impacts will continue concurrent with implementation of the Selected Remedy for OU#2.

The ROD for OU#1 stated that intermediate groundwater, sediments and surface water would be addressed in a separate ROD. To that end, a second operable unit was established to address those media as components of OU#2, the subject of this ROD which presents the final response action for the CPA Site under the authority of CERCLA. OU#2 addresses the principal threat through removal of DNAPL to the maximum extent practical. OU#2 continues the phased approach for groundwater cleanup through removal or treatment of DNAPL to the maximum extent practical, followed by containment of the non- restorable DNAPL source areas and restoration of the aqueous phase plume.

5.0 SITE CHARACTERISTICS

5.1 Physical Characteristics

Physical characteristics of the CPA Site pertinent to OU# 2 include the stratigraphy and aquifer characteristics of the intermediate zone, and surface water hydrology including associated sediments.

5.1.1 Intermediate Zone Stratigraphy

The CPA Site is located in the Atlantic Coastal Plain Province in southeastern South Carolina. The site is located west of the Cooper River on the Charleston Peninsula, in an area of filled tidal creek channels and fill placed along the shoreline of the Cooper River. The following sequence of hydrostratigraphic units have been identified to locally underlie the CPA Site:

- Fill material/upper sand;
- Upper clay;
- Upper intermediate sand;
- Middle intermediate sand;
- Lower intermediate sand; and
- Ashley Formation of the Cooper Group.

The deposits above the Ashley Formation represent partially filled-backbarrier, barrier island, and shallow-marine-shelf deposits that formed during interglacial periods. The intermediate water-bearing zone at the CPA Site is defined as the interval between the upper clay and Ashley Formation. The upper clay unit is relatively shallow (approximately 10 feet bgs on average) and acts as a layer of low permeability that impedes the vertical migration of DNAPL and dissolved phase constituents that are present in the shallow groundwater at portions of the CPA Site. The formations comprising the Cooper Group provide a relatively shallow, regional ubiquitous “base” to the shallow hydrostratigraphic system in Charleston, Dorchester, and western Berkeley Counties (Edwards and others, 1997).

Borings completed during the Intermediate Groundwater Remedial Pre-Design Characterization activities led to a revised understanding of the site hydrostratigraphy. The intermediate groundwater zone is characterized as generally heterogeneous, and is most appropriately described using the upper, middle and lower intermediate sand nomenclature. The upper intermediate sand unit is present in the northwest portion of the site (near the former gas holder), but does not extend laterally to the east (i.e., across the SCE&G substation and former Luden’s property). The upper intermediate sand unit is not confined by an overlying clay in the area to the west of the gas holder. Figure 5-1 presents a color-coded intermediate monitoring well location map. The present understanding of geologic site conditions is graphically represented in the geologic cross- sections provided as Figures 5-2 and 5-3.

5.1.2 Intermediate Zone Aquifer Characteristics

Aquifer Hydraulics

Hydraulic conductivity is a measurement of the ability of a water-bearing unit to transmit water. Horizontal hydraulic conductivity within the intermediate zone was estimated through slug testing during initial RI activities, with reported values ranging from 2.3 x 10-4 to 1.1 x 10-2 cm/sec. The average value (5. 6 x 10-3 cm/sec) is similar to the average value calculated for the shallow groundwater zone. Preliminary findings from slug testing at intermediate wells conducted during the remedial pre-design characterization activities indicate that the upper sand unit exhibits the lowest horizontal hydraulic conductivity and greatest heterogeneity, while the lower sand unit has the highest horizontal hydraulic conductivity and least apparent heterogeneity (MTR, February 2002). The general trend is for an increase in horizontal hydraulic conductivity with depth.

Groundwater elevation data obtained during the RI at nested well locations indicate a potential for downward movement of groundwater. However, vertical hydraulic conductivity estimates for the upper clay (average of 3.4 x 10-7 cm/sec) and Ashley Formation (average of 8.6 x 10-8 cm/sec) are relatively low. These low values indicate that those units are relatively impermeable and act as aquitards where present that limit the vertical movement of groundwater.

Potentiometric Elevations and Groundwater Flow

In contrast to shallow groundwater flow, the intermediate groundwater flow does not appear influenced by man-made structures such as subsurface storm drains. There is also an apparent tidal influence present within the intermediate zone at well locations close to the Cooper River. As noted in describing the stratigraphy at the CPA Site, the intermediate zone is comprised of upper, middle and lower intermediate sand units. Groundwater elevation contours and flow directions have been evaluated for each unit.

Groundwater elevation contours for the upper intermediate sand unit infer that groundwater flow converges toward the northeast corner of the SCE&G substation. The hydraulic gradient appears to be very low, and groundwater flow is minimal within the upper intermediate sand unit. Groundwater within the middle intermediate sand unit generally flows from west to east. At the eastern portion of the SCE&G substation (well nest MM-16 area), groundwater flow appears to be impeded by an increase in the bottom clay structure elevation and saltwater intrusion from the Cooper River. Analytical data support this understanding of groundwater flow within the middle intermediate sand unit. The lower intermediate sand unit is characterized by five monitoring wells installed at the site, four of which are installed within the electrical substation, that indicate a generally eastern flow direction.

Utilizing data from the November 2000 monitoring event, the horizontal hydraulic gradient for the intermediate zone was calculated to be 0.0013 toward the east, with a gradient of 0.0044 for the northeastern component of flow. Assuming a uniform horizontal hydraulic conductivity occurring vertically within the sand units of the intermediate zone (at an estimated value of 5.6 x 10-3 cm/sec), a porosity of 0.3, and horizontal hydraulic gradients ranging from 0.0013 to 0.0044, the average linear groundwater flow velocity is estimated to be between 0.07 and 0.23 feet per day (approximately 25 to 85 feet per year).

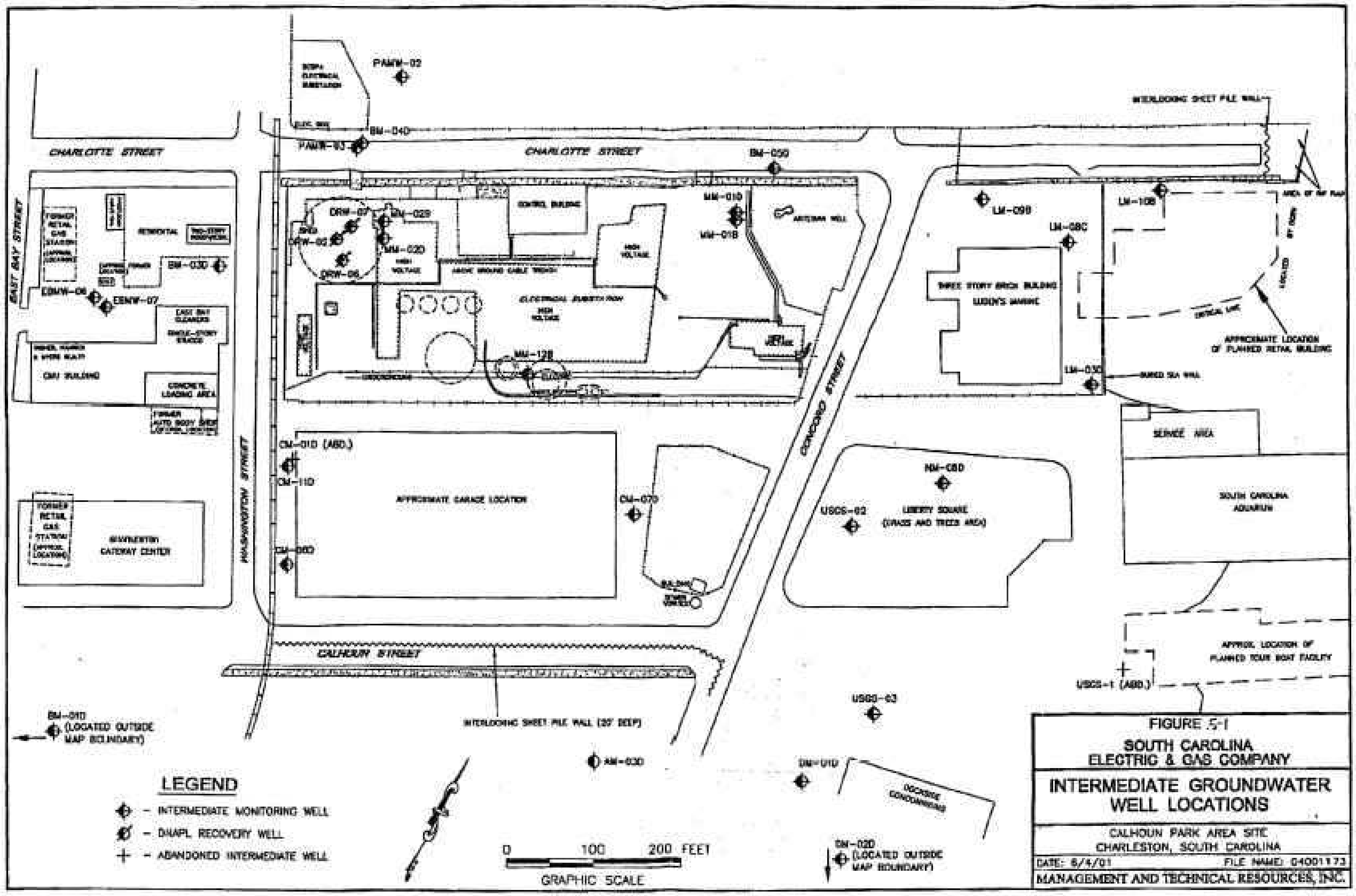
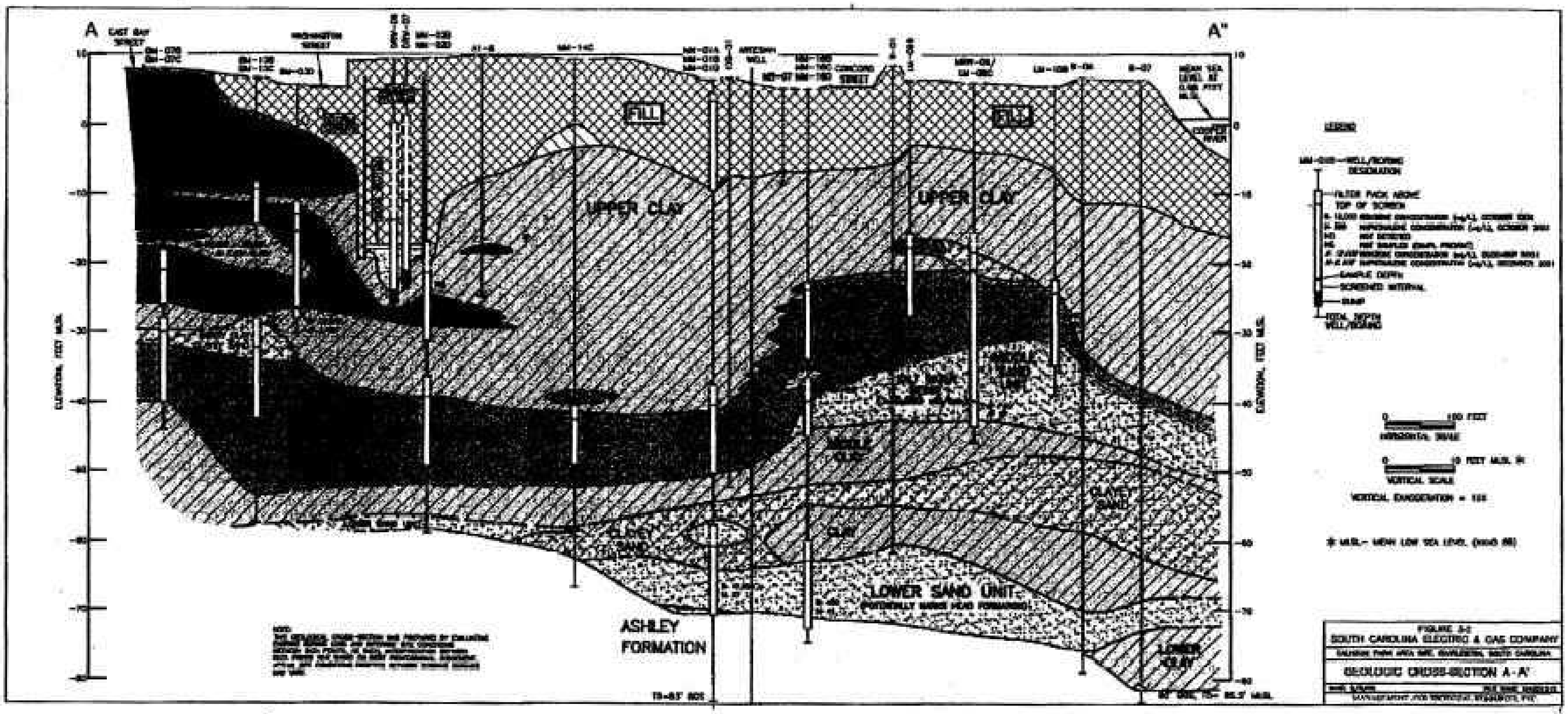


FIGURE 5-1
SOUTH CAROLINA ELECTRIC & GAS COMPANY
INTERMEDIATE GROUNDWATER WELL LOCATIONS
CALHOUN PARK AREA SITE
CHARLESTON, SOUTH CAROLINA
DATE: 6/4/01
FILE NAME: 04001173
MANAGEMENT AND TECHNICAL RESOURCES, INC.
LEGEND
- INTERMEDIATE MONITORING WELL
- DNAPL RECOVERY WELL
- ABANDONED INTERMEDIATE WELL
0 100 200 FEET
GRAPHIC SCALE
CHARLOTTE STREET
CALHOUN STREET
CONCORD STREET
WASHINGTON STREET
EAST BAY STREET
PAMW-02
PAMW-03
BM-04D
BM-05D
BM-03D
BM-01D (LOCATED OUTSIDE MAP BOUNDARY)
EBMW-06
EBMW-07
DRW-07
DRW-02
DRW-06
MM-02S
MM-02D
MM-01D
MM-01S
MM-12S
LM-09B
LM-08C
LM-10B
LM-03D
CM-01D (ABD.)
CM-11D
CM-06D
CM-07D
NM-08D
USGS-02
USGS-03
USGS-1 (ABD.)
AM-03D
DM-01D
DM-02D (LOCATED OUTSIDE MAP BOUNDARY)
CONTROL BUILDING
HIGH VOLTAGE
ELECTRICAL SUBSTATION
APPROXIMATE GARAGE LOCATION
CMU BUILDING
CONCRETE LOADING AREA
CHARLESTON GATEWAY CENTER
THREE STORY BRICK BUILDING
LIBERTY SQUARE (GRASS AND TREES AREA)
SERVICE AREA
SOUTH CAROLINA AQUARIUM
APPROXIMATE LOCATION OF PLANNED RETAIL BUILDING
APPROX. LOCATION OF PLANNED TOUR BOAT FACILITY
INTERLOCKING SHEET PILE WALL
INTERLOCKING SHEET PILE WALL (20' DEEP)
DOCKSIDE CONDOMINIUMS



A
A"
FILL
FILL
UPPER CLAY
UPPER CLAY
LOWER SAND UNIT
ASHLEY FORMATION
LOWER CLAY
CLAYEY SAND
CLAY
LEGEND
VERTICAL SCALE
SOUTH CAROLINA ELECTRIC & GAS COMPANY
GEOLOGIC CROSS-SECTION A-A'

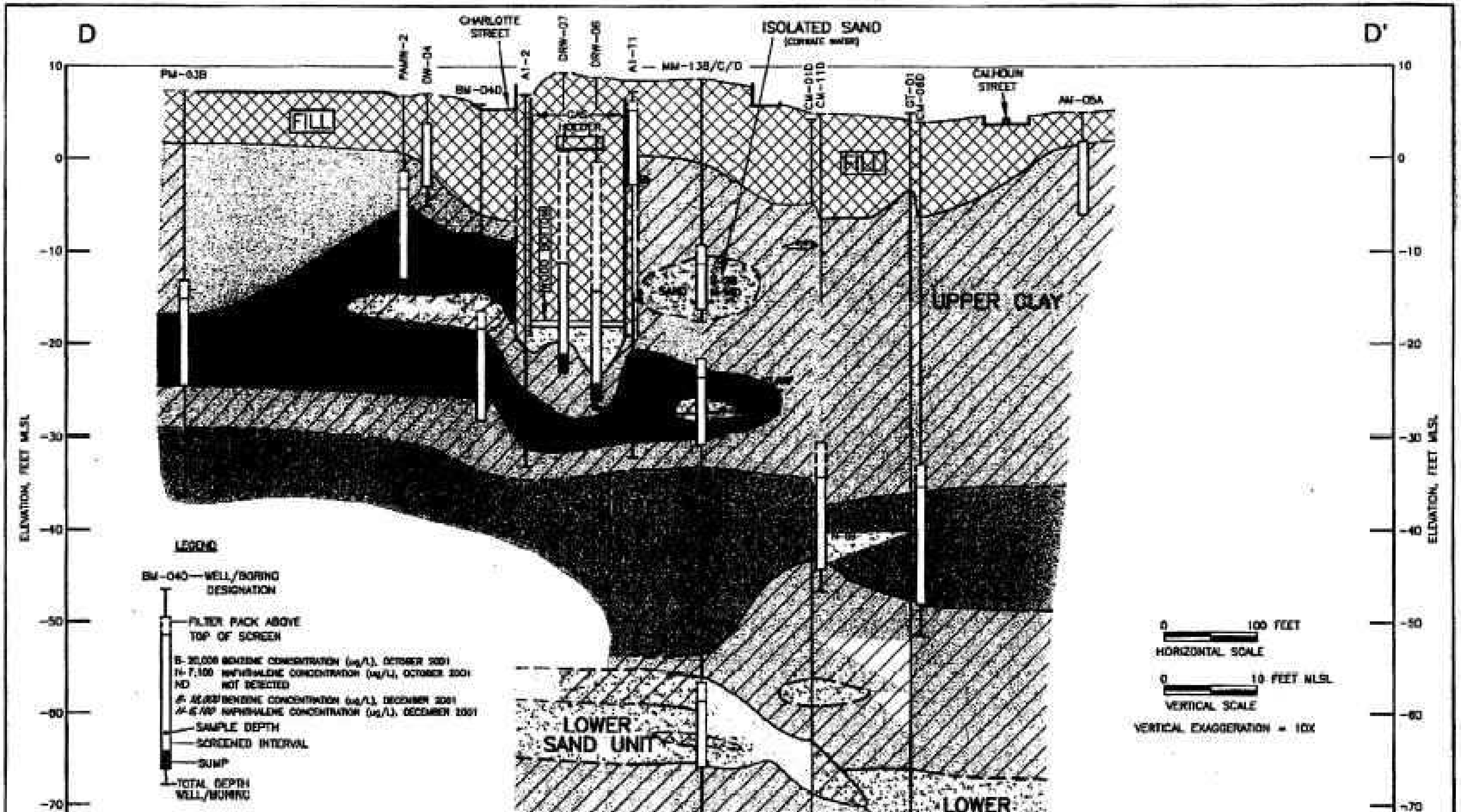


FIGURE 5-3
SOUTH CAROLINA ELECTRIC & GAS COMPANY
CALHOUN PARK AREA SITE, CHARLESTON, SOUTH CAROLINA
GEOLOGIC CROSS-SECTION D-D'
MANAGEMENT AND TECHNICAL RESOURCES, INC.

5.1.3 Surface Water Hydrology and Sediments

The CPA Site is located adjacent to the west bank of the Cooper River, the major surface water in the immediate vicinity of the site. The Cooper River is a freshwater tributary to the Charleston Harbor, a brackish, semi-enclosed water body. The Cooper River and Charleston Harbor represent an estuarine environment due to their proximity to the Atlantic Ocean, and are tidally influenced with a semidiurnal tide that averages 5.2 feet. The site lies above normal high tide levels, although the 50-year storm surge level for Charleston County would cause flooding of the site.

Surface water drainage occurs either as overland flow or through stormwater collection systems. Important features of the CPA Site related to surface water drainage are the former Calhoun Street drain and the existing stormwater drain along Charlotte Street. Replacement of the former Calhoun Street drain, an old underground brick archway that extended to the Cooper River, was completed in 1997. The former drain was replaced with a new pipe that connects to a pump station along Concord Street. The pump station allows discharge of stormwater during high tide conditions in the river. The former Calhoun Street drain was plugged with flowable fill and abandoned. The stormwater drain along Charlotte Street terminates at an outfall to the Cooper River located immediately south of the SCSPA facility. The Charlotte Street drain receives stormwater runoff from a system of drains that extends to the center of the Charleston Peninsula. Improvements to the end of the storm drain, including installation of a check valve to prevent tidal backflow, were completed in 1999 following the seep mitigation activities.

Sediments of interest at the CPA Site occur within the Cooper River, particularly along the right descending bank between the former Charlotte Street seep area and the former Calhoun Street drain outfall. The Town Creek Channel of the Cooper River is adjacent to the NPS and Luden’s properties, and is used by ships that dock at the SCSPA facility adjacent to the CPA Site. Sediment that accumulates within the channel is routinely removed through dredging conducted by the U. S. Army Corps of Engineers, to maintain the river channel for traffic to the adjacent facility. The bottom substrate is composed of clay and fine sand with a high organic content.

The river shoreline between Charlotte Street and the former Calhoun Street drain outfall has been redeveloped since 1998, and large areas of the former shoreline sediments are now essentially covered by new structures or sand blankets placed during construction activities.

Also, sediment at the end of Charlotte Street was removed in 1999 during seep mitigation activities, and the sediment was replaced with a sand blanket over the excavated area.

5.2 Nature and Extent of Constituent Impacts

5.2.1 Intermediate Groundwater

DNAPL Occurrence

DNAPL has been observed (and periodically removed) at three monitoring well locations within the intermediate groundwater zone at the site. Well MM-02B is located adjacent to the former gas holder, which has been evaluated as a DNAPL source area. The occurrence of DNAPL appears limited to within the immediate vicinity of the gas holder foundation.

DNAPL accumulations have also occurred at middle intermediate sand unit monitoring wells MM-01B and MM-15C. Well MM-01B is located within the former rail spur DNAPL source area on the eastern portion of the electrical substation. The DNAPL present in well MM-01B is likely caused by vertical migration at a breach of the upper clay unit.

DNAPL has not been observed in any lower intermediate sand unit monitoring well. The findings of the supplemental groundwater investigations indicate that the presence of DNAPL within the intermediate zone is limited to the three areas identified above.

Dissolved Phase Occurrence

Benzene, toluene, ethylbenzene and xylenes (BTEX) and semi-volatile constituents were detected in several intermediate well samples during the original RI. The highest concentrations were localized in the area of the former MGP (former gas holder area), the eastern end of the substation (vicinity of the artesian well), and the western boundary of the former Calhoun Park (adjacent to the parking garage). Groundwater quality data indicated that benzene and naphthalene were the primary constituents of interest in the intermediate water-bearing zone.

Supplemental investigations confirmed previously documented groundwater impacts, and provided information to delineate the horizontal and vertical extent of dissolved phase constituents in the intermediate zone. The data collected to date indicate that dissolved phase site-related constituents are not reaching the Cooper River. The supplemental investigations also indicated additional benzene detections to the west of the former MGP at higher concentrations than previously observed. Groundwater flow within the intermediate water-bearing zone is generally to the east. Therefore, the detections to the west are presumably upgradient from the gas holder.

Preliminary findings associated with implementation of the Intermediate Groundwater Remedial Pre-Design Characterization Work Plan have resulted in a better understanding of the intermediate groundwater zone units at the site. Consequently, a revised grouping of monitoring wells has been developed based upon the sand unit in which the well screen was installed. The preliminary findings indicate that vertical delineation of dissolved phase constituents has been completed, and that horizontal delineation has been completed to the north, east and south. There was an area east of MM-16D which needs an additional well. This will be resolved by the addition of well LM-10D. The pre-design activities did not confirm nor disprove the existence of an upgradient benzene source to the west/northwest of the site.

Tables 5-1 and 5-2 provide a concise summary of historical intermediate groundwater quality data for benzene and naphthalene, respectively. Supplemental groundwater quality data from the October and December 2001 sampling events are provided in Tables 5-3 through 5-5 for the upper, middle and lower intermediate sand units, respectively. The occurrence of dissolved phase constituents is discussed below for each unit within the intermediate groundwater zone.

Upper Intermediate Sand Unit

Groundwater quality in the upper intermediate sand unit is generally characterized by elevated benzene and naphthalene concentrations. Coal tar impacts were observed in saturated zone soil samples collected at well locations to the north and west of the gas holder. Available information regarding groundwater flow indicates that those locations may be hydraulically upgradient of the site. Based on the elevated benzene concentrations detected in groundwater samples collected at wells presumably upgradient of the former gas holder, it appears there may be co-mingling of coal tar constituents with an upgradient benzene plume.

Middle Intermediate Sand Unit

Groundwater quality in the middle intermediate sand unit is characterized by the highest benzene concentration reported in the upper intermediate sand unit. A similar decrease occurs with naphthalene concentrations. Generally, the upper bounds of the benzene concentration range for the middle intermediate sand unit was between 5,100 and 18,000 μg/L, with naphthalene concentrations ranging from 1,800 to 6,700 μg/L.

From a spatial perspective, it appears that a benzene plume (either MGP-related or other) exists upgradient to the west of the former gas holder. As groundwater moves eastward through the middle intermediate sand unit, benzene concentrations increase near the gas holder, attenuate somewhat near well MM-14C (central substation area), and increase at well MM-01B due likely to the occurrence of DNAPL in that area. At the well nest MM-16 location (adjacent to Concord Street), groundwater flow and constituent migration appear to be impeded by an increase in the bottom clay structure elevation and saltwater intrusion. Impacts at well LM-09B (east of Concord Street) are presumed to be isolated to that area.

Lower Intermediate Sand Unit

Dissolved phase constituents within the lower intermediate sand unit appear to be limited to the area surrounding wells MM-01D and MM-16D, both located near the artesian well. Benzene concentrations decrease significantly in the direction of groundwater flow (from well MM-01D to well MM-16D). Vertical dissolved phase migration is expected to be stratigraphically limited by the presence of clay layers within the intermediate zone, and ultimately by the Ashley Formation.

5.2.2 Sediment

Information regarding sediments obtained during initial RI activities is summarized in the RI Report (Fluor Daniel GTI, September 1996) and the initial ROD for the site. The analytical results were compared to relevant ecological screening criteria, and indicated that the primary constituents of concern in sediments were PAHs. Sediment samples with the highest PAH concentrations were clustered in two primary areas: the former Calhoun Street drain outfall and the area adjacent to NPS property. An assessment of benthic macroinvertabrates was also performed on a portion of the Cooper River adjacent to the site. The findings at the close of the initial RI/FS indicated that there were no significant differences between on- site and off-site stations. However, coal tar seeps appeared at the end of Charlotte Street following completion of the RI Report and prior to issuance of the original ROD for the CPA Site, which represented a new source for potential sediment impacts. Therefore, additional investigative activities were proposed.

Sediment investigative activities completed subsequent to the initial RI included sampling conducted in June 1997, and the sediment characterization conducted in November and December 1999. Findings from these activities are summarized in the RI Addendum Report – Additional Sediment Sampling (Fluor Daniel GTI, October 1997) and the Interim Report on Additional Sediment and Surface-Water Characterization (Godfrey and Associates, February 2000). The information provides an updated understanding of the nature and extent of impacts to sediment associated with the CPA Site, and was used to prepare an updated ecological risk assessment (ERA) (Godfrey and Associates, April 2002).

In summary, a final set of contaminants of concern (COPCs) and specific areas of potential concern were established for sediments in the problem formulation step of the ERA. The sediment areas of potential concern based on the ERA are identified on Figure 1-4, and include the former Charlotte Street seep area and the sediments adjacent to the NPS property. The areas of concern were calculated using alternative benchmarks expressed as Ecological Sediment Guidelines Toxicity Units (ESGTUs). Figure 1-4 provides central tendency estimates of ESGTUs using the 1999 8.5% average Foc values. Some uncertainty is associated with the fact that sample specific FOC data are unavailable for a majority of stations in the Brick Archway exposure group, and application of proxy Foc data to these stations was necessary to derive HQs using alternative benchmarks. Stations outside the sand blanket without station-specific Foc data are depicted on Figure 6-3.

5.2.3 Surface Water

Information regarding surface water obtained during the initial RI activities is summarized in the RI Report (Fluor Daniel GTI, September 1996) and the initial ROD for the site. Surface water samples were collected from the Cooper River, as well as flood water surrounding the Ansonborough Homes property and storm water outfalls. The analytical results were compared to ambient water quality criteria (AWQC), which indicated that the detected constituents were not above the AWQC standards. However, because of the coal tar seeps that appeared at the end of Charlotte Street following the initial RI activities, representing a new source for potential surface water impacts, additional investigative activities were proposed.

TABLE 5-1

SUMMARY OF HISTORICAL INTERMEDIATE GROUNDWATER QUALITY DATA FOR BENZENE

Calhoun Park Area Site
Charleston, South Carolina

Well	Units	January 1994	December 1998	March 1999	May 2000	August 2000 [1]	August 2000 [2]	November 2000 [1]	November 2000 [2]
AM-03D	ug/L	200 U	5 U	--	1.0 U	--	--	--	5 U
BM-01D	ug/L	10 U	5 U	--	1.0 U	--	--	--	5 U
BM-03D	ug/L	--	--	--	60,000	29,000	--	42,000	30,000
BM-04D	ug/L	--	--	--	38,000	14,000	25,700 J	29,000	20,000
BM-05D	ug/L	--	--	--	1,400	46	65	--	220
CM-06D	ug/L	--	--	--	2.6	--	--	--	5 U
CM-07D	ug/L	--	--	--	1.0 U	--	--	--	5 U
CM-01D*/CM-11D**	ug/L	15,000	--	--	9,400	9,900	12,300	14,000	12,000
DM-01D	ug/L	10 U	5 U	--	1.0 U	--	--	--	5 U
DM-02D	ug/L	10 U	5 U	--	--	--	--	--	--
DRW-02	ug/L	--	4,600	--	4,500	9,500	--	15,000	9,200
DRW-06	ug/L	--	--	--	--	--	--	6,800	--
LM-03D	ug/L	10 U	5 U	5 U	1.0 U	--	--	--	5 U
LM-08C	ug/L	--	--	--	1.0 U	--	--	--	5 U
LM-09B	ug/L	--	--	1,900	2,600	2,200	--	--	2,000
LM-10B*	ug/L	--	--	5 U	1.0 U	--	--	--	--
MM-01B	ug/L	3,600	19,000	--	36,000	14,000	--	--	11,000
MM-01D	ug/L	4,500	12,000	--	--	--	--	--	--
MM-02B	ug/L	--	19,000	--	50,000	8,500	--	47,000	28,000
MM-02D	ug/L	1,800	19,000	--	--	--	--	--	--
MM-12B	ug/L	--	--	--	5,700	430	565	--	1,800
NM-06D	ug/L	--	--	--	1.0 U	--	--	--	5 U
USGS-01*	ug/L	3 J	--	--	--	--	--	--	--
USGS-02	ug/L	10 U	5 U	--	1.0 U	--	--	--	5 U
USGS-03	ug/L	50 U	5 U	--	1.0 U	--	--	--	5 U
EBMW-06	ug/L	--	--	--	--	--	--	43	29
EBMW-07	ug/L	--	--	--	--	--	--	17 J	12
PAMW-02	ug/L	--	--	--	--	--	--	5,100	4,200
PAMW-03	ug/L	--	--	--	--	--	--	310	290

Notes:

Jan - 94: RI/FS conducted by Fluor Daniel GTI

Dec - 98: Groundwater sampling and analyses conducted by Fluor Daniel GTI

Mar - 99: Investigation of the Luden's property conducted by IT Corporation

May - 00: Additional characterization of the intermediate groundwater zone conducted by Godwin and Associates

Aug - 00(1): Confirmational groundwater monitoring activities conducted by MTR and analyzed by SPL

Aug - 00(2): Confirmational groundwater monitoring activities conducted by MTR and analyzed by Centre

Nov - 00(1): Supplemental intermediate groundwater assessment conducted by Ish Inc

Nov - 00(2): Comprehensive intermediate groundwater monitoring conducted by MTR

U - Indicates that the constituent was not detected at the reported detection limits

J - Indicates an estimated value. The constituent was positively identified. However, the result was less than the quantitation limit but greater than zero or based on the data evaluation, the associated result is an approximate concentration of the constituent in the sample.

-- indicates that the constituent was not analyzed

* - abandoned well.

** - replacement well.

TABLE 5-2

SUMMARY OF HISTORICAL INTERMEDIATE GROUNDWATER QUALITY DATA FOR NAPHTHALENE

Calhoun Park Area Site
Charleston, South Carolina

Well	Units	January 1994	December 1998	March 1999	May 2000	August 2000[1]	August 2000[2]	November 2000[1]	November 2000[2]
AM-03D	ug/L	10 U	9.6 U	--	20 U	--	--	--	10 U
BM-01D	ug/L	10 U	9.4 U	--	10 U	--	--	--	10 U
BM-03D	ug/L	--	—	—	9,800	3,600	--	15,000	9,500
BM-04D	ug/L	—	—	—	12,000	6,800	8,520 J	17,000	5,600
BM-05D	ug/L	—	--	--	870	730	345	—	25
CM-06D	ug/L	--	—	--	10 U	--	--	--	10 U
CM-07D*	ug/L	--	--	—	10 U	--	--	—	10 UJ
CM-01D*/CM-11D**	ug/L	67	—	—	32	43	17.4	200 J	10 U
DM-01D	ug/L	10 U	9.5 U	—	10 U	--	--	--	10 U
DM-02D	ug/L	10 U	10 U	—	--	--	--	--	--
DRW-02	ug/L	--	2,800	—	4,100	3,700	--	13,000	4,100 J
DRW-06	ug/L	—	—	—	--	--	—	8,300	--
LM-03D	ug/L	10 U	9.9 U	5 U	20 U	--	--	--	10 U
LM-08C	ug/L	—	--	--	42	--	--	—	10 UJ
LM-09B	ug/L	--	—	5,100	4,800	3,200 J	--	--	710 J
LM-10B*	ug/L	--	--	10	10 U	—	—	--	—
MM-01B	ug/L	--	20,000	—	5,600	6,200	--	—	11,000
MM-01D	ug/L	30	100	--	—	--	--	—	--
MM-02B	ug/L	--	5,000	--	4,100	6,200	—	18,000	380 J
MM-02D	ug/L	3,400	9.9 U	—	--	--	--	--	--
MM-12B	ug/L	--	--	—	680	170	150	--	10 U
NM-06D	ug/L	--	—	--	10 U	--	—	—	10 U
USGS-01*	ug/L	3 J	--	--	--	--	—	—	--
USGS-02	ug/L	5 J	25 U	--	10 U	--	--	--	10 U
USGS-03	ug/L	10 U	9.8 U	--	10 U	--	--	--	10 U
EBMW-06	ug/L	--	--	--	—	--	—	0.99 J	10 U
EBMW-07	ug/L	--	--	--	—	—	--	0.62 J	10 U
PAMW-02	ug/L	--	--	—	--	—	--	220 J	10 U
PAMW-03	ug/L	—	—	—	--	—	--	6.4 J	10 U

Notes:

Jan - 94: RI/FS conducted by Fluor Daniel GTI

Dec - 98: Groundwater sampling and analyses conducted by Fluor Daniel GTI

Mar - 99: Investigation of the Luden's property conducted by IT Corporation

May - 00: Additional characterization of the intermediate groundwater zone conducted by Godfrey and Associates

Aug - 00(1): Confirmational groundwater monitoring activities conducted by MTR and analyzed by SPL

Aug - 00(2): Confirmational groundwater monitoring activities conducted by MTR and analyzed by Centre

Nov - 00(1): Supplemental intermediate groundwater assessment conducted by Iah Inc

Nov - 00(2): Comprehensive intermediate groundwater monitoring conducted by MTR

U - Indicates that the constituent was not detected at the reported detection limits.

J - Indicates an estimated value. The constituent was positively identified. However, the result was less than the quantitation limit but greater than zero or based on the data evaluation, the associated result is an approximate concentration of the constituent in the sample.

UJ - indicates that the constituent was not detected above the reporting limit. However, based on the data evaluation, the reported result is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the concentration of the constituent in the sample.

-- indicates that the constituent was not analyzed.

* - abandoned well

** - replacement well

TABLE 5-3

UPPER SAND UNIT GROUNDWATER ANALYTICAL RESULTS
OCTOBER 2001 AND DECEMBER 2001

SCE&G Calhoun Park Area Site
Charleston, South Carolina

CONSTITUENT	UNITS	BM-03D	BM-03D Upper	BM-03D Upper	BM-03D Lower	BM-04D	BM-07B	BM-08B	BM-10B	EBMW-06	EBMW-07	MM-02B	MM-13B**	MM-13C	MM-13C	PAMW-02	PM-03B
Volatiles			Re-sample 12/4/01	Duplicate 12/4/01	Re-sample 12/4/01										Re-sample 12/5/01		
Benzene	ug/L	35,000	45,000 J	32,000 J	53,000 J	20,000	5 U	45.000	38	25	35	NS	28	56,000	43,000 J	2,600	5 U
Ethylbenzene	ug/L	3.800	5,300	5,500	5,000	2,700	5 U	3.600	5 U	5 U	5 U	NS	5 U	3,700	6,000	7	5 U
Toluene	ug/L	4.200	5,900	6.000	5,100	1,400	5 U	8,000	5 U	5 U	5 U	NS	5 U	890	1,600	5 U	5 U
Xylenes, Total	ug/L	2,800	3,800	3.900	3,600	2,600	5 U	4,500	5 U	5 U	5 U	NS	19	1,870	3,600	22	5 U
1,2-Dibromoethane	ug/L	25 U	--	--	--	25 U	5 U	100 U	5 U	5 U	5 U	NS	5 U	25 U	--	5 U	5 U
1,2-Dichloroethane	ug/L	25 U	--	--	--	25 U	5 U	100 U	5 U	5 U	5 U	NS	5 U	25 U	--	5 U	5 U
Methyl tert-butyl ether	ug/L	25 U	--	--	--	25 U	5 U	100 U	5 U	5 U	5 U	NS	5 U	25 U	--	5 U	5 U
Total Alky-lead	ug/L	5.54 U	--	--	--	5.58 U	5.60 U	5.80 U	5.63 U	5.67 U	5.52 U	NS	5.62 U	5.54 U	--	5.61 U	5.68
Semi-Volatiles																	
2-Methylnaphthalene	ug/L	680	680	640	470	490	5 U	540	5 U	5 U	5 U	NS	5 U	400	600	5 U	5 U
2,4-Dimethylphenol	ug/L	35	25	18	15	24	10 U	35	10 U	10 U	10 U	NS	10 U	35	47	10 U	10 U
Acenaphthene	ug/L	17	10	10	10 U	10	10 U	10 U	10 U	10 U	10 U	NS	10 U	43	43	10 U	10 U
Acenaphthylene	ug/L	49	29	26	24	32	10 U	12	10 U	10 U	10 U	NS	10 U	32	28	10 U	10 U
Anthracene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NS	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NS	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NS	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NS	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NS	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NS	10 U	10 U	10 U	10 U	10 U
Carbazole	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NS	10 U	10 U	10	10 U	10 U
Chrysene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NS	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NS	10 U	10 U	10 U	10 U	10 U
Dibenzofuran	ug/L	10 U	5 U	5 U	5 U	10 U	NR	10 U	10 U	10 U	10 U	NS	10 U	10 U	6	10 U	10 U
Fluoranthene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NS	10 U	10 U	10 U	10 U	10 U
Fluorene	ug/L	19	12	11	10	12	10 U	10 U	10 U	10 U	10 U	NS	10 U	19	23	10 U	10 U
Indeno(1,2,3-cd)pyrene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NS	10 U	10 U	10 U	10 U	10 U
Naphthalene	ug/L	11,000	7,800	6,800	5,700	7,100	10 U	12.000	10 U	10 U	10 U	NS	10 U	4.600	5.500	10 U	10 U
Phenanthrene	ug/L	18	14	13	12	11	10 U	10 U	10 U	10 U	10 U	NS	10 U	22	29	10 U	10 U
Pyrene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NS	10 U	10 U	10 U	10 U	10 U
Inorganics																	
Cyanide, Available	ug/L	2 U	--	--	--	5	2 UJ	11 J	2 J	4	2 U	NS	4	4	--	3	5 J
Pre-Design Parameters																	
Alkalinity	mg/L	398	--	--	--	473	378	--	--	--	--	NS	--	--	--	1,640	--
Biological Oxygen Demand	mg/L	452	--	--	--	488	29 6	--	--	--	--	NS	--	--	--	109	--
Chemical Oxygen Demand	mg/L	84	--	--	--	164	5 U	--	--	--	--	NS	--	--	--	84	--
Iron, Dissolved	mg/L	0.612	--	--	--	0.925	0.543	--	--	--	--	NS	--	--	--	16.1	--
Manganese, Dissolved	mg/L	0 832	--	--	--	0.162	1.02	--	--	--	--	NS	--	--	--	0.75	--
Nitrite	mg/L	0.1	--	--	--	0.1 U	0.1 U	--	--	--	--	NS	--	--	--	0.1 U	--
Nitrate	mg/L	0.1 U	--	--	--	0.1 U	0.1 U	--	--	--	--	NS	--	--	--	0.1 U	--
Sulfate	mg/L	4.51 U	--	--	--	1 U	127	--	--	--	--	NS	--	--	--	1 U	--
Sulfide	mg/L	0.036	--	--	--	0.047	0.02 U	--	--	--	--	NS	--	--	--	0.025	--
Total Dissolved Solids	mg/L	562	--	--	--	684	714	--	--	--	--	NS	--	--	--	2,720	--
Total Suspended Solids	mg/L	6.9	--		--	14.6	1 U	--	--	--	--	NS	--	--	--	103	--

Notes:
U - Indicates that the compound was not detected at the reported detection limit.

TABLE 5-4

MIDDLE SAND UNIT GROUNDWATER ANALYTICAL RESULTS
OCTOBER 2001 AND DECEMBER 2001

SCE&G Calhoun Park Area Site
Charleston, South Carolina

CONSTITUENT	UNITS	AM-03D	BM-05D	BM-06C	BM-07C	BM-08C	BM-10C	CM-06D	CM-106D	CD-07D	CM-11D	DM-01D	LM-03D	LM-08C	LM-08C Upper	LM-08C Lower	LM-09B	LM-10B
									Duplicate						Re-sample 12/3/01	Re-sample 12/3/01		
Volatiles																		
Benzene	ug/L	5 U	14	100	780	10.000	14.000	5 U	--	5 U	5.600	5 U	5 U	25 U	7 UJ	6 UJ	3.000	5 U
Ethylbenzene	ug/L	5 U	5 U	5 U	130	1.300	800	18	--	5 U	13	5 U	5 U	25 U	5 UJ	5 UJ	1.700	110
Toluene	ug/L	5 U	5 U	5 U	170	820	260	5 U	--	5 U	5	5 U	5 U	25 U	5 UJ	5 UJ	22	5 U
Xylenes, Total	ug/L	5 U	28	5 U	130	720	260	19	--	5 U	18	5 U	5 U	25 U	8 J	5 UJ	790	48
1,2-Dibromoethane	ug/L	5 U	--	5 U	5 U	250 U	250 U	--	--	--	5 U	--	--	--	--	--	--	--
1,2-Dichloroethane	ug/L	5 U	--	5 U	5 U	250 U	250 U	--	--	--	5 U	--	--	--	--	--	--	--
Methyl tert-butyl ether	ug/L	5 U	--	5 U	5 U	250 U	250 U	--	--	--	5 U	--	--	--	--	--	--	--
Total Alky-lead	ug/L	--	--	5.69 U	5.63 U	5.84 U	5.64 U	--	--	--	5.50 U	--	--	--	--	--	--	--
Semi-Volatiles																		
2-Methylnaphthalene	ug/L	5 U	24	5 U	5 U	14	42	5 U	--	5 U	5 U	5 U	5 U	9	22	6	320	5 U
2,4-Dimethylphenol	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthene	ug/L	10 U	13	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	130	10 U
Acenaphthylene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Anthracene	ug/L	10 U	12	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbazole	ug/L	10 U	52	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	46	10 U
Chrysene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenzofuran	ug/L	NR	28	10 U	NR	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	16	5 U	32	10 U
Fluoranthene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	ug/L	10 U	42	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	15	10 U	41	10 U
Indeno(1,2,3-cd)pyrene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Naphthalene	ug/L	10 U	10 U	10 U	13	2.800	1.800	10 U	--	10 U	69	10 U	10 U	33	67	19	3.200	10 U
Phenanthrene	ug/L	10 U	69	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	22	10 U	53	10 U
Pyrene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Inorganics																		
Cyanide, Available	ug/L	–	10	5 J	5 J	3 J	25 J	3	2 U	2 UJ	2 J	--	--	--	--	--	9 J	6 J
Pre-Design Parameters																		
Alkalinity	mg/L	--	--	--	170	--	--	--	--	--	416	--	--	--	--	--	1.670	--
Biological Oxygen Demand	mg/L	--	--	--	32.6	--	--	--	--	--	74	--	--	--	--	--	177	--
Chemical Oxygen Demand	mg/L	--	--	--	11 U	--	--	--	--	--	55 U	--	--	--	--	--	99	--
Iron, Dissolved	mg/L	--	--	--	0.02 U	--	--	--	--	--	3.43	--	--	--	--	--	1.25	--
Manganese, Dissolved	mg/L	--	--	--	0.014	--	--	--	--	--	0 111	--	--	--	--	--	0.147	--
Nitrite	mg/L	--	--	--	0.1 U	--	--	--	--	--	0.1 U	--	--	--	--	--	0 1 U	--
Nitrate	mg/L	--	--	--	0.1 U	--	--	--	--	--	0.1 U	--	--	--	--	--	0.1 U	--
Sulfate	mg/L	--	--	--	17.4	--	--	--	--	--	1 U	--	--	--	--	--	135	--
Sulfide	mg/L	--	--	--	0.713	--	--	--	--	--	0.094	--	--	--	--	--	0.02 U	--
Total Dissolved Solids	mg/L	--	--	--	431	--	--	--	--	--	2.490	--	--	--	--	--	11.30	--
Total Suspended Solids	mg/L	--	--	--	1 U	--	--	--	--	--	8 9	--	--	--	--	--	0 19.5	--

Notes:
U - Indicates that the compound was not detected at the reported detection limit.
J - Indicates an estimated value. The constituent was positively identified; however, the result is less than the quantitation limit but greater than zero
NR - not repoted.

Table 5-4 (Continued)

MIDDLE SAND UNIT
OCTOBER 2001 INTERMEDIATE GROUNDWATER ANALYTICAL RESULTS

SCE&G Calhoun Park Area Site
Charleston, South Carolina

CONSTITUENT	UNITS	MM-01B	MM-01B	MM-02D	MM-12B	MM-14C	MM-15C	MM-16B	MM-16B	MM-16C	MM-16C	NM-06D	NM-106D	PM-01C	PM-02B	PM-102B	USGS-02	USGS-03	USGS-103
Volatiles			Re-sample 12/4/01						Re-sample 12/3/01		Re-sample 12/3/01		Duplicate			Duplicate			Duplicate
Benzene	ug/L	18,000	18,000 J	15,000	750	5.400	5,100	5 U	5 UJ	5 U	5 UJ	5 U	5 U	1,200	6	5	5 U	5 U	5 U
Ethylbenzene	ug/L	1.500	2.100	1.300	44	660	750	5 U	5 UJ	5 U	5 UJ	5 U	5 U	150	5 U	5 U	5 U	5 U	5 U
Toluene	ug/L	1,700	2.900	25 U	10 U	38	3,000	5 U	5 UJ	5 U	5 UJ	5 U	5 U	9	5 U	5 U	5 U	5 U	5 U
Xylenes, Total	ug/L	1,700	2.500	260	81	550	1,500	5 U	5 UJ	5 U	5 UJ	5 U	5 U	110	5 U	5 U	5 U	5 U	5 U
1,2-Dibromoethane	ug/L	--	--	25 U	--	--	--	5 U	--	5 U	--	--	--	--	--	--	--	--	--
1,2-Dichloroethane	ug/L	--	--	25 U	--	--	--	5 U	--	5 U	--	--	--	--	--	--	--	--	--
Methyl tert-butyl ether	ug/L	--	--	25 U	--	--	--	5 U	--	5 U	--	--	--	--	--	--	--	--	--
Total Alky-lead	ug/L	--	--	5.80 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Semi-Volatiles																			
2-Methylnaphthalene	ug/L	5 U	940	190	7	920	990	5 U	5 U	5 U	5 U	5 U	5 U	17	5 U	5 U	5 U	5 U	5 U
2,4-Dimethylphenol	ug/L	10 U	190	10 U	10 U	220	230	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthene	ug/L	10 U	72	12	10 U	97	41	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	ug/L	10 U	36	10 U	10 U	39	180	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Anthracene	ug/L	10 U	10 U	10 U	10 U	10	11	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbazole	ug/L	10 U	190	10 U	10 U	180	110	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chrysene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenzofuran	ug/L	10 U	37	10 U	10 U	46	29	NR	5 U	NR	5 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluoranthene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	ug/L	10 U	58	10 U	10 U	69	63	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Naphthalene	ug/L	560	6.100	3.600	150	6.700	3,800	10 U	11	10 U	10 U	10 U	10 U	160	28	25	10 U	10 U	10 U
Phenanthrene	ug/L	10 U	54	16	10 U	73	64	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pyrene	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Inorganics																			
Cyanide, Available	ug/L	16 J	--	6	7 J	14 J	3	2 UJ	--	2 UJ	--	--	--	2 UJ	5 J	3 J	--	--	--
Pre-Design Parameters																			
Alkalinity	mg/L	783	--	407	--	931	1,310	1.710	--	1810	--	--	--	--	2.260	2,230	--	--	--
Biological Oxygen Demand	mg/L	80.2	--	117	--	72.4	99.2	26.6	--	44.4	--	--	--	--	94.6	93.3	--	--	--
Chemical Oxygen Demand	mg/L	117	--	118	--	75	178	138	--	85	--	--	--	--	124	127	--	--	--
Iron, Dissolved	mg/L	0.144	--	0.439	--	0 274	0.584	0.732	--	0 242	--	--	--	--	0.758	0.723	--	--	--
Manganese, Dissolved	mg/L	0.159	--	0 043	--	0 335	0.338	0.805	--	0 055	--	--	--	--	0.061	0.061	--	--	--
Nitrite	mg/L	0.1 U	--	0.1 U	--	0.1 U	0.1 U	0.1 U	--	0.1 U	--	--	--	--	0.1 U	0.1 U	--	--	--
Nitrate	mg/L	0.1 U	--	0.1 U	--	0.1 U	0.1 U	0.1 U	--	0.1 U	--	--	--	--	0.1 U	0.1 U	--	--	--
Sulfate	mg/L	1 U	--	1 U	--	12	11.6	45.8	--	13.9	--	--	--	--	6.77 J	1 UJ	--	--	--
Sulfide	mg/L	3.12	--	0 291	--	2.64	0.02 U	0.02 U	--	0.02 U	--	--	--	--	0.02 U	0.02 U	--	--	--
Total Dissolved Solid	mg/L	4,190	--	646	--	6.630	10,600	13,000	--	17,800	--	--	--	--	15,100	15,200	--	--	--
Total Suspended Solids	mg/L	2	--	2.8	--	3 8	9.8	14.3	--	5.9	--	–	--	--	14	12 8	--	--	--

Notes:
U - Indicates that the compound was not detected at the detection limit.
J - Indicates an estimated value. The constituent was positively identified; however, the result is less than the quantitation limit but greater than zero.
NR - Not reported

Table 5

LOWER SAND UNIT GROUNDWATER ANALYTICAL RESULTS
OCTOBER 2001 AND DECEMBER 2001

SCE&G Calhoun Park Area Site
Charleston, South Carolina

CONSTITUENT	UNITS	DM-02D	MM-10D	MM-13D	MM-16D	MM-16D
Volatiles						
Benzene	ug/L	5 U	12,000	5 U	5 U	430
Ethylbenzene	ug/L	5 U	1.500	5 U	5 U	59
Toluene	ug/L	5 U	100 U	5 U	5 U	5 U
Xylenes, Total	ug/L	5 U	240	5 U	5 U	87
1,2-Dibromoethane	ug/L	–	–	5 U	5 U	5 U
1,2-Dichloroethane	ug/L	–	–	5 U	5 U	5 U
Methyl tert-butyl ether	ug/L	–	–	5 U	5 U	5 U
Total Alky-lead	ug/L	–	–	--	--	
Semi-Volatiles						
2-Methylnaphthalene	ug/L	5 U	5 U	5 U	5 U	5 U
2,4-Dimethylphenol	ug/L	10 U	10 U	10 U	10 U	280
Acenaphthene	ug/L	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	ug/L	10 U	10 U	10 U	10 U	10 U
Anthracene	ug/L	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	ug/L	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	ug/L	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	ug/L	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	ug/L	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	ug/L	10 U	10 U	10 U	10 U	10 U
Carbazole	ug/L	10 U	10 U	10 U	10 U	10 U
Chrysene	ug/L	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	ug/L	10 U	10 U	10 U	10 U	10 U
Dibenzofuran	ug/L	10 U	10 U	10 U	10 U	NR
Fluoranthene	ug/L	10 U	10 U	10 U	10 U	10 U
Fluorene	ug/L	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	ug/L	10 U	10 U	10 U	10 U	10 U
Naphthalene	ug/L	10 U	67	10 U	10 U	41
Phenanthrene	ug/L	10 U	10 U	10 U	10 U	10 U
Pyrene	ug/L	10 U	10 U	10 U	10 U	10 U
Inorganics						
Cyanide, Available	ug/L	--	6 J	2 UJ	2 UJ	2 UJ
Pre-Design Parameters						
Alkalinity	mg/L	–	482	–	–	–
Biological Oxygen	mg/L	–	77.1	–	–	–
Demand	mg/L	–	88	–	–	–
Chemical Oxygen	mg/L	–	0.02 U	–	–	–
Demand	mg/L	–	0.049	–	–	–
Iron, Dissolved	mg/L	–	0 1 U	–	–	–
Manganese, Dissolved	mg/L	–	0.1	–	–	–
Nitrite	mg/L	–	1 U	–	–	–
Nitrate	mg/L	–	7.36	–	--	–
Sulfate	mg/L	–	2,110	–	–	–
Sulfide	mg/L	–	2	–	–	–
Total Dissolved Solid	mg/L					
Total Suspended Solids	mg/L					

Notes:
U - Indicates that the compound was not detected at the reported detection limit.
J - Indicates an estimated value. The constituent was positively identified, however, the results is less than the quantitaiton limit but greater than zero
NR - Not reported.

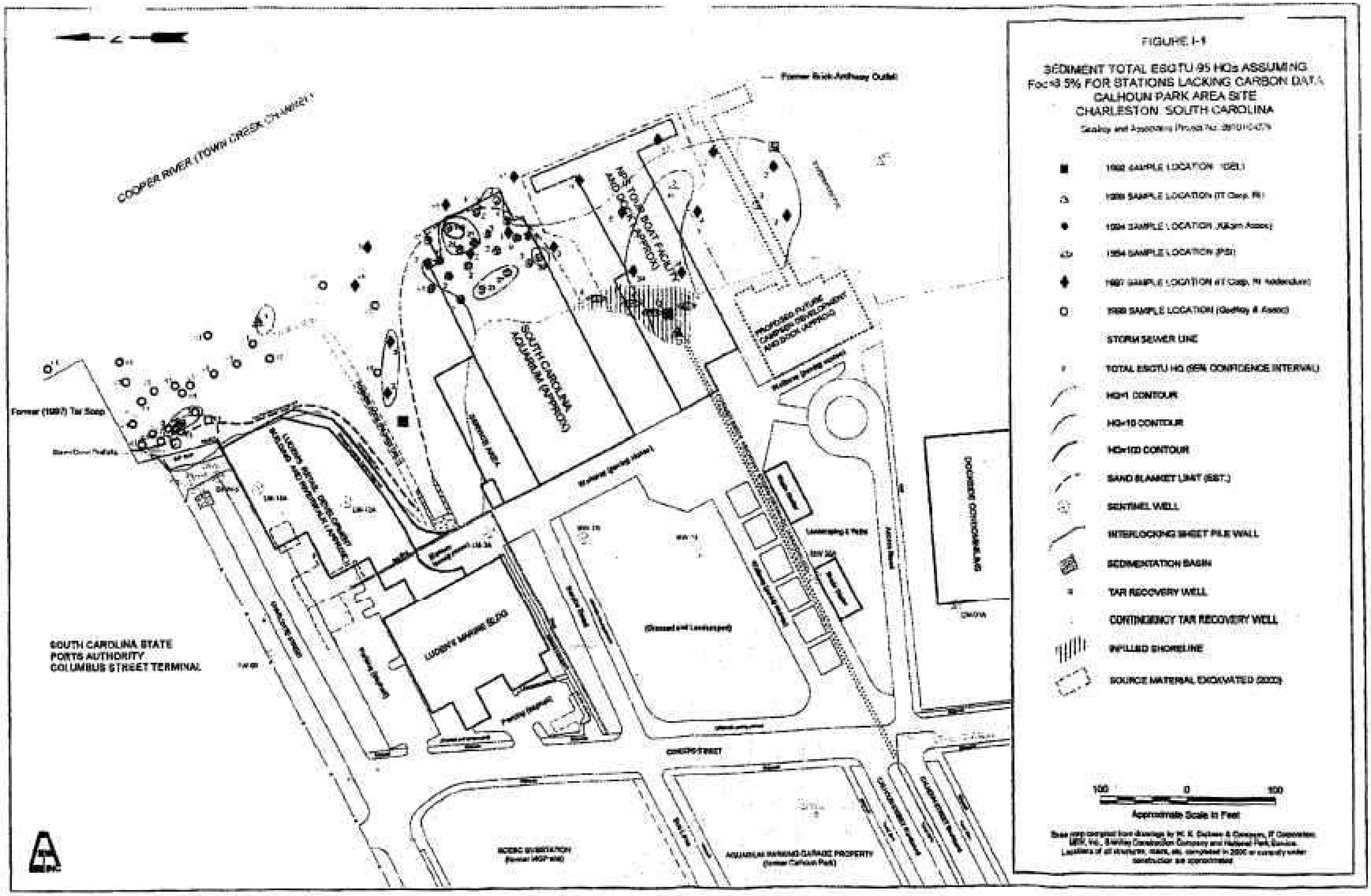


FIGURE I-1

SEDIMENT TOTAL ESGTU-95 HQs ASSUMING Foc=3.5% FOR STATIONS LACKING CARBON DATA
CALHOUN PARK AREA SITE
CHARLESTON, SOUTH CAROLINA

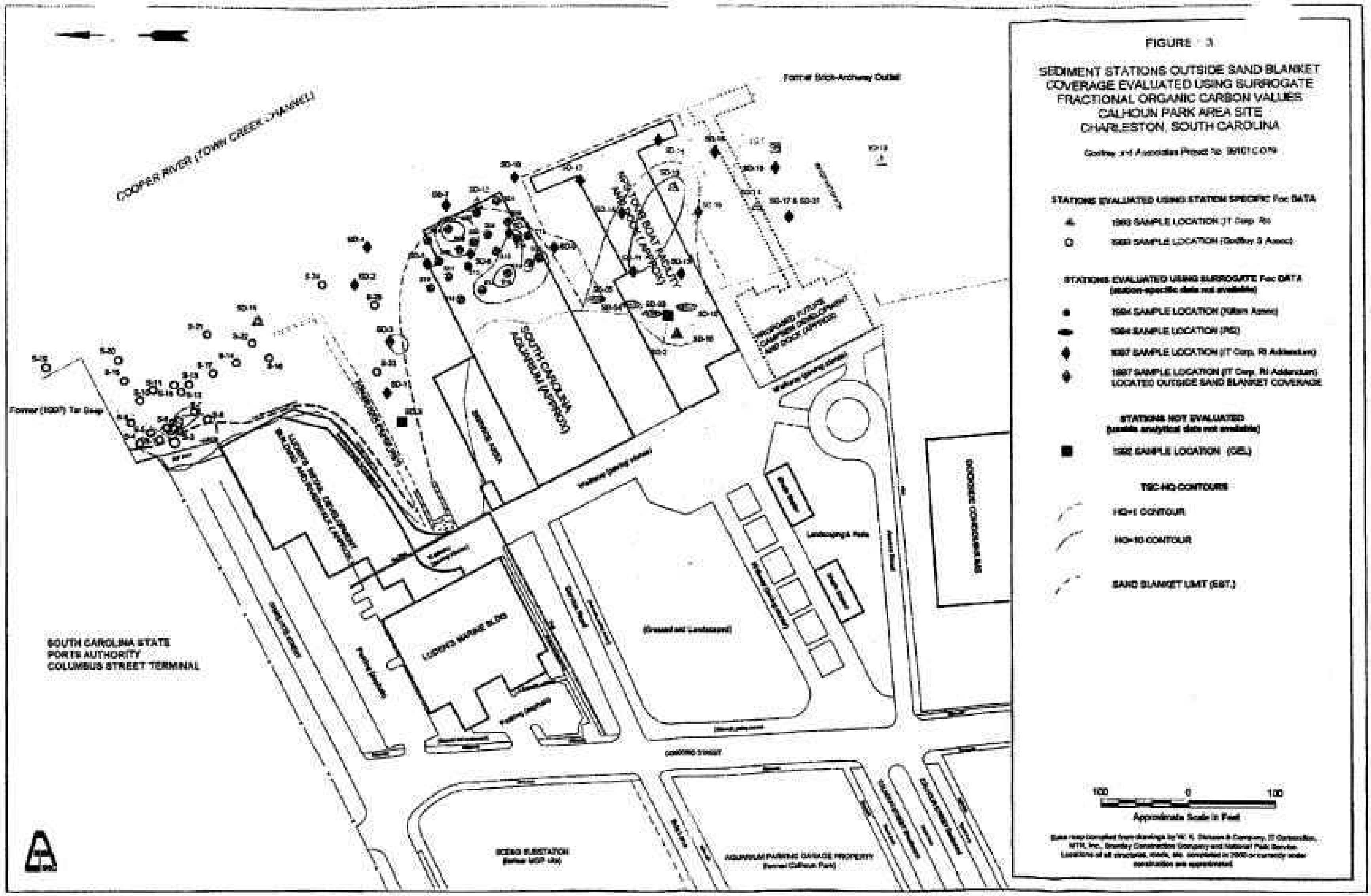


FIGURE 3
SEDIMENT STATIONS OUTSIDE SAND BLANKET COVERAGE EVALUATED USING SURROGATE FRACTIONAL ORGANIC CARBON VALUES
CALHOUN PARK AREA SITE
CHARLESTON, SOUTH CAROLINA
COOPER RIVER (TOWN CREEK CHANNEL)
SOUTH CAROLINA AQUARIUM (APPROX.)
SOUTH CAROLINA STATE
PORTS AUTHORITY
COLUMBUS STREET TERMINAL
TSC-HQ CONTOURS
SAND BLANKET LIMIT (EST.)
Approximate Scale in Feet

Additional surface water investigative activities were conducted subsequent to the initial RI by Godfrey and Associates in November and December 1999. Findings from these activities are summarized in the Interim Report on Additional Sediment and Surface-Water Characterization (Godfrey and Associates, February 2000). The information provides an updated understanding of the nature and extent of constituent impacts to surface water associated with the CPA Site, and was used to prepare an updated ecological risk assessment (ERA) (Godfrey and Associates, April 2002).

Based on the available lines of evidence, the potential for ecological impacts from MGP-related constituents in surface water at the brick archway area is very low. Therefore, none of the surface water constituents were retained as final COPCs and surface water has been eliminated from further consideration as a medium of concern.

5.3 Conceptual Site Model

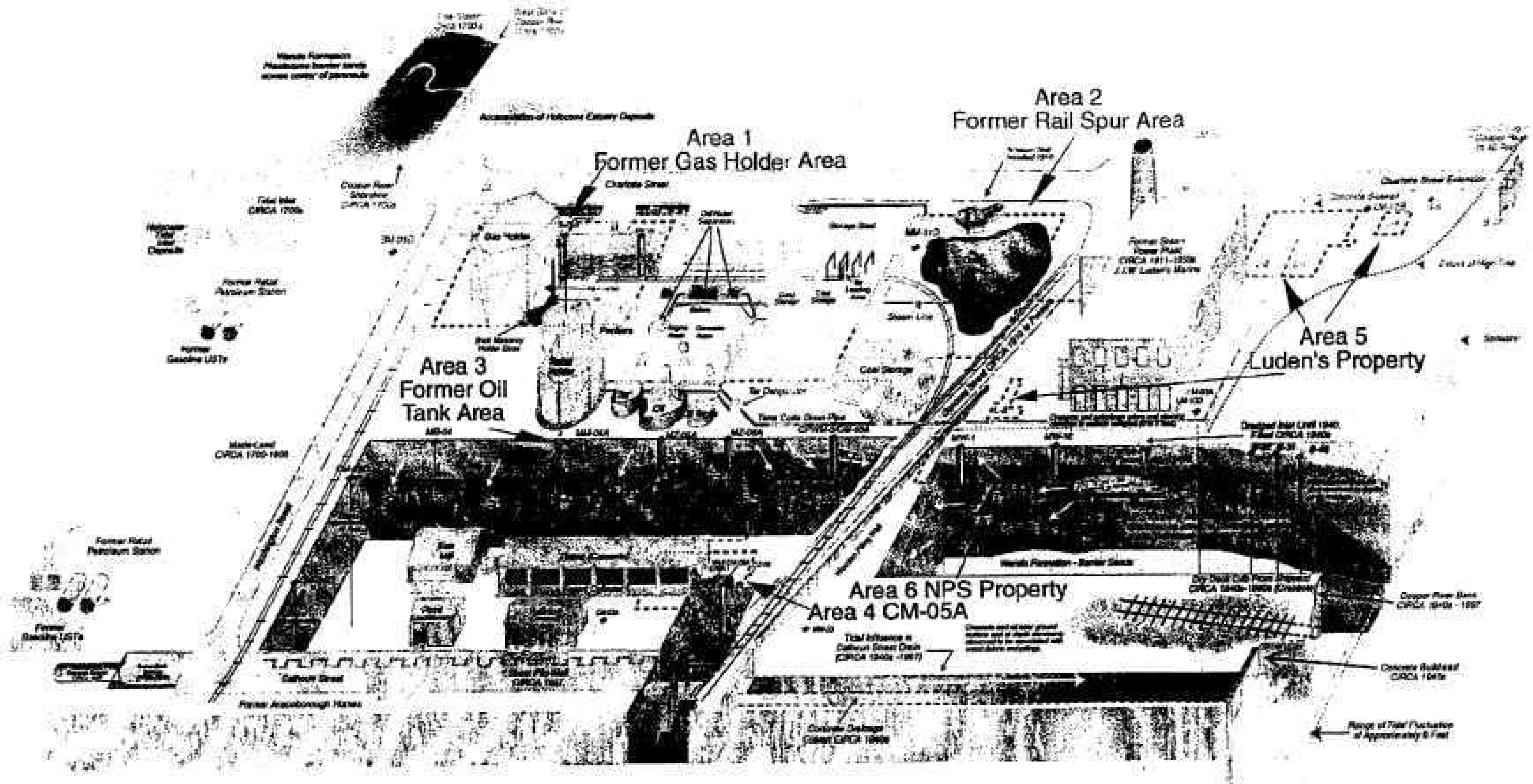
The conceptual site model (CSM) reflects the current understanding of subsurface conditions relative to the intermediate water-bearing zone at the CPA Site. The physical component of the CSM, discussed in detail in Section 5.1, provides an understanding of the site conditions that relate to the hydrogeologic setting and the geochemistry of the intermediate water- bearing zone. The chemical component characterizes the occurrences of DNAPL and dissolved phase constituent plumes (see Section 5.2). The physical and chemical components combine to form a CSM that describes the three-dimensional site conditions. Figures 5-5 and 5-6 graphically represent the CSM features discussed below.

5.3.1 Physical Setting

Figure 5-5 shows the location of the CPA Site in relation to the current right descending bank of the Cooper River, as well as the original river shoreline location in the late-1700s near Washington Street, prior to development of the site vicinity in the early to mid-1800s. The area to the east of the CPA Site is man-made land, created by the placement of various types of fill over a tidal marsh and estuary deposits. The CSM shows some of the historical land use on this strip of artificial fill, which because of the site location near the river, includes chemical production and land use related to shipping. The portion of the CPA Site of primary interest is currently bordered by Charlotte Street (north), Calhoun Street (south), Concord Street (east) and Washington Street (west), and is approximately eight acres in size.

The coastal South Carolina region has a temperate climate generally characterized by a wet season (May-September) and a dry season (October-April). The wet season is characterized by intense sun and unstable atmospheric conditions that result in frequent thunderstorms with intense rainfall of short duration. In contrast, the dry season is characterized by mild, dry weather with frontal storms, that typically have moderate amounts of low intensity rainfall. On average, Charleston receives about 48 inches of rainfall annually. The potential for evapotranspiration is relatively high, at 34 inches per year (Krause and Randolph, 1989).

As shown on Figure 5-6, prior to 1910, the MGP was initially located adjacent to the Cooper River to receive coal from ships. The Cooper River is a freshwater tributary to the Charleston Harbor, a brackish, semi-enclosed water body as previously discussed in Section 5.1.3. Adjacent to the NPS and Luden’s properties, the Town Creek Channel of the Cooper River is presently maintained by the U. S. Army Corps of Engineers through dredging to a draft depth of 40 feet. The channel is used by merchant marine ships that dock at the adjacent Ports Authority facility. Because of the dredging, the upper portion of the intermediate water-bearing zone is exposed to the surface water of the Cooper River, and intermediate groundwater is influenced by tidal fluctuations.



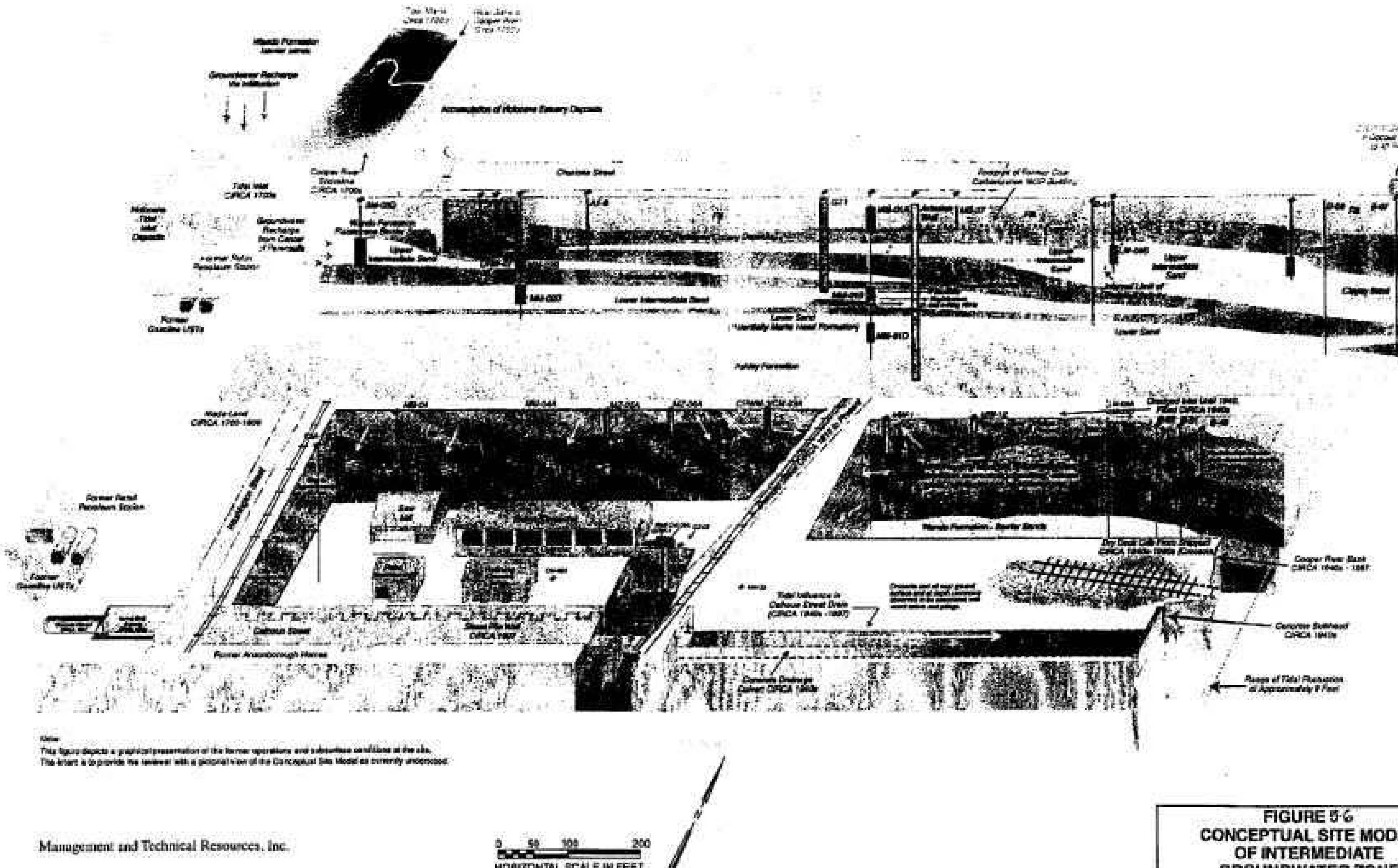
Note:
This figure depicts a graphical presentation of the former operations and subsurface conditions at the site.
The intent is to provide the reviewer with a pictorial view of the Conceptual Site Model as currently understood.

Management and Technical Resources, Inc.

0 50 100 200
HORIZONTAL SCALE IN FEET

FIGURE 5-5
CONCEPTUAL SITE MODEL

SOUTH CAROLINA
ELECTRIC & GAS COMPANY
CALHOUN PARK AREA SITE
CHARLESTON, SOUTH CAROLINA



Note:
This figure depicts a graphical presentation of the former operations and subsurface conditions at the site.
The intent is to provide the reviewer with a pictorial view of the Conceptual Site Model as currently understood.

Management and Technical Resources, Inc.

0 50 100 200
HORIZONTAL SCALE IN FEET

FIGURE 5-6
CONCEPTUAL SITE MODEL OF INTERMEDIATE GROUNDWATER ZONE
SOUTH CAROLINA ELECTRIC & GAS COMPANY
CALHOUN PARK AREA SITE
CHARLESTON, SOUTH CAROLINA

5.3.2 Geology and Hydrogeology

Stratigraphy

The CPA Site is located west of the Cooper River on the Charleston Peninsula, in an area of filled tidal creek channels and fill placed along the river shoreline. Figure 5-6 shows that the Intermediate water-bearing zone at the CPA Site has been subdivided on a local basis into separate hydrostratigraphic units. Regionally, it is undifferentiated and referred to as the “surficial aquifer”. On a peninsula-wide basis, the upper portion of the intermediate water-bearing zone has more sand content than the lower portion. Therefore, the upper portion is thicker and tends to be more laterally continuous, while the lower portion occurs within clay and is likely to be localized and of limited extent.

The intermediate water-bearing zone at the CPA Site is generally heterogeneous and defined as the interval between the upper clay unit and Ashley Formation of the Cooper Group, and includes the upper, middle and lower intermediate sand units. The upper intermediate sand, present in the northwest portion of the CPA Site (near the former gas holder), does not extend laterally to the east (i.e., across the SCE&G substation and former Luden's property). The upper clay layer was not encountered above the upper intermediate sand in the area to the west of the gas holder. Where present, the upper clay is a relatively shallow (approximately 10 feet bgs on average) layer of low permeability that impedes the vertical migration of DNAPL and dissolved phase constituents. The formations comprising the Cooper Group provide a relatively shallow, regional ubiquitous “base” to the shallow hydrostratigraphic system.

Aquifer Hydraulics

The lithology of the intermediate groundwater zone results in considerable variations in hydraulic conductivities and a heterogeneous flow system. Horizontal hydraulic conductivity (the ability of a water-bearing unit to transmit water) was estimated within the intermediate zone through slug testing, and the values averaged 5.6 x 10-3 cm/sec, similar to the shallow groundwater zone. Preliminary findings from slug testing conducted during remedial pre-design activities indicate that the upper sand unit exhibits the lowest horizontal hydraulic conductivity and greatest heterogeneity. The general trend is for an increase in horizontal hydraulic conductivity and reduction in apparent heterogeneity with depth.

Groundwater elevation data obtained during the RI at nested well locations indicate a potential for downward movement of groundwater. However, vertical hydraulic conductivity estimates for the upper clay and Ashley Formation are relatively low, indicating that those units are relatively impermeable and act as aquitards that limit the vertical movement of groundwater.

Potentiometric Elevations and Groundwater Flow

The hydraulic gradient and geologic variations of the intermediate zone control the specific flow paths between recharge and discharge areas. The site area is generally underlain by an upper clay unit which acts as an aquitard. Therefore, the recharge area for the intermediate zone is the interior of the Charleston peninsula. Groundwater throughout the intermediate zone generally flows from west to east toward the Cooper River. In contrast to shallow groundwater flow, intermediate groundwater flow does not appear influenced by man- made structures such as subsurface storm drains. Nominal groundwater level increases in intermediate zone are expected in response to precipitation events, whereas water levels can fluctuate significantly in the shallow water- bearing zone due to precipitation. There is also an apparent tidal influence present within the intermediate zone at well locations close to the Cooper River.

As noted in describing the site stratigraphy, the intermediate zone is comprised of upper, middle and lower intermediate sand units. Groundwater elevation contours for the upper intermediate sand unit infer that groundwater flow converges toward the northeast corner of the SCE&G substation. The hydraulic gradient appears to be very low, and groundwater flow within the upper intermediate sand is minimal to stagnant. Groundwater flow within the middle intermediate sand unit is generally from west to east. At the eastern portion of the SCE&G substation (well nest MM-16 area), middle intermediate groundwater flow appears to be impeded by an increase in the bottom clay structure elevation and influenced by saltwater intrusion from the Cooper River. Groundwater elevations indicate a generally eastern flow direction within the lower intermediate sand.

Assuming the average horizontal hydraulic conductivity estimated to be 5.6 x 10-3 cm/sec is uniform vertically within the sand units of the intermediate zone, a porosity of 0.3, and horizontal hydraulic gradients ranging from 0.0013 to 0.0044, the average linear groundwater flow velocity is estimated to be between 0.07 and 0.23 feet per day (approximately 25 to 85 feet per year).

5.3.3 Nature and Extent of Constituent Impacts

DNAPL Occurrence

The MGP coal gasification process produced coal tar (a DNAPL) as a by-product. Based on the accumulations of DNAPL at the base of the shallow water-bearing zone, the upper clay layer impedes the vertical migration of DNAPL except in areas where the clay layer is breached. For the CPA Site, DNAPL entry locations to the intermediate water-bearing zone may include the former gas holder in Area 1, and the geotechnical borings in Area 2. These potential DNAPL entry locations are proximal to monitoring wells with accumulations of DNAPL.

DNAPL has been observed at three monitoring well locations screened within the upper or middle intermediate groundwater zones. DNAPL has not been observed in any lower intermediate sand unit well. The occurrence of DNAPL in well MM-02B appears limited to within the immediate vicinity of the gas holder foundation.

DNAPL accumulations have also occurred at middle intermediate sand unit wells MM-01B and MM-15C. Well MM-01B is located in the eastern portion of the electrical substation, and is in the vicinity of a geotechnical boring installed in 1979 prior to construction of the electrical substation. DNAPL was reportedly encountered in the shallow zone and no protective casings were installed as the boring was advanced.

Dissolved Phase Occurrence

Once DNAPL is distributed into the saturated zone, groundwater will flow through these impacted areas. Leaching and migration of DNAPL constituents results in a dissolved phase plume that will continue to develop until all free phase and residual DNAPL has been dissolved and the leading edge of the plume is at steady-state conditions. Because groundwater has a higher relative flow through in a residual zone than in a DNAPL pool, residual DNAPL dissolves more quickly. The time required to completely dissolve residual DNAPL depends on several factors, including groundwater velocity, the constituent composition of the DNAPL, and the affected porous media properties. At the CPA Site, a heterogeneous distribution of hydraulic conductivities will cause groundwater to flow preferentially through coarser-grained lenses and laminations, resulting in less than optimal contact with residual DNAPL and pool zones. Therefore, the life span of residual DNAPL can be on the order of several decades to centuries.

The highest dissolved phase concentrations appear to be localized in the area of the former MGP (former gas holder area), the eastern end of the substation (vicinity of the artesian well), and the western boundary of the former Calhoun Park (adjacent to the parking garage). Sufficient groundwater quality data are available to delineate the horizontal and vertical extent of dissolved phase constituents, and indicate that benzene and naphthalene are the primary constituents of interest in the intermediate water-bearing zone. Vertical delineation of dissolved constituents has been completed, and horizontal delineation has been completed to the north, east and south. There was an area east of MM-16D and southeast of MM 13C which needs an additional well. This will be resolve by the addition of well LM-10D. The benzene detections to the west of the former MGP are presumably upgradient from the CPA Site. Dissolved constituents are not reaching the Cooper River, the presumed downgradient ecological receptor.

The variability of hydrogeologic conditions has resulted in variable dissolved phase constituent concentrations at different depth intervals, which supports the conceptual understanding of an upper, middle and lower sand unit within the intermediate zone at the CPA Site. The upper intermediate sand unit is generally characterized by elevated benzene and naphthalene concentrations. As the physical component of the CSM indicates, the upper clay may not be present above the upper intermediate sand to the west of Washington Street. The elevated benzene concentrations to the north and west (presumed upgradient) of the former gas holder indicate there may be co-mingling of coal tar constituents with another benzene plume. However, the existence of an upgradient benzene source has not been confirmed or disproved.

Benzene and naphthalene concentrations decrease significantly from the upper to middle intermediate sand units. From a spatial perspective, it appears that a benzene plume exists to the west of the former gas holder that is impacting the middle intermediate sand unit. As groundwater moves eastward, benzene concentrations increase near the gas holder, attenuate somewhat in the central substation area, and increase at well MM-01B due to the DNAPL occurrence in that area. At the well nest MM-16 location (adjacent to Concord Street), constituent migration appears to be impeded by an increase in the bottom clay structure elevation and saltwater intrusion. Impacts at monitoring well LM-09B (east of Concord Street) appear to be isolated to that area.

Dissolved constituents within the lower intermediate sand unit appear limited to the area surrounding wells MM-01D and MM-16D, located near the artesian well. The source is thought to be the geotechnical borings completed prior to substation construction. Benzene concentrations decrease significantly in the presumed direction of groundwater flow. Vertical dissolved phase migration is stratigraphically retarded by the presence of clay layers within the intermediate zone, and ultimately by the Ashley Formation.

Sediments

Impacted sediments associated with the site occurred through two primary mechanisms: the discharge associated with the old brick archway, and the occurrence of a coal tar seep at the end of Charlotte Street.

The presence of a coal tar seep, adjacent to the storm water outfall at the end of Charlotte Street, was identified as a source of coal tar present in the sediments. This seep, which was observed discharging coal tar into the sediment and surface water in 1997, was the subject of an interim removal action in 1998. The old brick archway, which discharged storm water runoff from inland areas into the Cooper River, may have also contributed to the sediment contamination observed in the adjacent river. Concentration gradients plotted for PAHs in sediments illustrate that the sediments of concern are located in the general area of the Charlotte Street seep and the area associated with the discharge pipe/old brick archway.

The MGP coal gasification process utilized an oil/water separator pipe which discharged into the Cooper River in the general area north of the old brick archway. It is likely that discharge from this pipe transported the lighter fractions of coal tar into the adjacent surface water and sediments within the Cooper River. The termination point of the discharge pipe was located approximately 300 feet inland from the present day shoreline, on Aquarium Wharf drive near Concord Street. The area surrounding the oil/water discharge pipe was and continues to be addressed as a shallow groundwater issue under OU#1.

Much of the land area on the NPS property, from Concord Street to the Cooper River, is comprised of fill material. The property was filled in the early 1940s with material from an unknown source. Historical photographs document that the property was used extensively for ship maintenance/repair and dry dock facilities were abundant. Marine maintenance products, such as rosin, turpentine and paint were produced and or used in the vicinity of the site. The use of marine paints containing heavy metals on the NPS property is well documented in previous reports.

The nature and extent of contaminated sediments is presented in the Remedial Investigation Report dated 1993, the Interim Report on Sediment and Surface Water Characterization dated February 2000, and the Interim Report on Ecological Risk Assessment dated April 2002. The sediment area of potential concern is identified on Figure 1-4, and include the former Charlotte Street seep area and the sediments adjacent to the NPS property.

5.3.4 Fate and Transport of Constituents of Interest

Dissolved phase plumes emanate from sources of constituents of interest within the intermediate zone. The idealized physical conceptual model of a DNAPL source consists of the DNAPL mass within the subsurface and the dissolved plume extending downgradient of the DNAPL zone. Dissolution of constituents from DNAPL occurs by groundwater movement through the DNAPL mass and is controlled by solubility. In terms of dissolution from tar, BTEX and naphthalene are the primary constituents of interest due to their relatively high aqueous solubility compared with the 4- and 5-ring PAH constituents which are four to five orders-of-magnitude less soluble. The main mechanism that allows constituent transport is the movement of the carrier, which is groundwater. The migration of groundwater containing dissolved phase constituents leads to the evolution of plumes extending downgradient of the DNAPL zone, in a direction controlled by gravity and geologic conditions. The mobility of an organic constituent is largely dependent upon its solubility, which is an inverse function of molecular weight.

The dissolved plume is created by advective and dispersive transport, and is affected by chemical retardation and biodegradation. These processes determine the size of a steady-state plume in a site-specific manner. Advection is the main transport process for solutes in a water-bearing zone. Dispersion is also a constituent transport process. At the CPA Site, the movement of the dissolved phase plume by advection and dispersion is modified by retardation processes, biochemical degradation, and abiotic degradation resulting in steady-state conditions. BTEX and naphthalene are readily degraded in groundwater systems, and the microorganisms capable of aerobically degrading these constituents are ubiquitous. However, the oxygen needed as an electron acceptor for aerobic degradation is quickly depleted, and anaerobic degradation processes proceed at a much slower rate. Biodegradation of the PAH constituents depends on the complexity of the PAH structure. The average linear groundwater velocity in the intermediate water-bearing zone is approximately four times lower than the velocity in the shallow water-bearing zone. Therefore, attenuation factors such as adsorption and biodegradation may be playing a larger role in exceeding the transport processes carrying the organic solutes because advection is a slower process. The groundwater monitoring data for the CPA Site indicate the existence of steady-state conditions in the intermediate zone.

The final COCs in sediment consist of PAHs. These PAHs are present in the sediments adjacent to the Charlotte Street seep area and the NPS property. PAHs are highly lipophilic and sorb to sediment organic matter. The fate and transport of these sediment-associated constituents are largely governed by surface water flow and sediment transport regimes within the Cooper River. During higher flow events bottom sediment could be re-suspended, transported and subsequently deposited at downgradient locations. Because the Cooper River is a dynamic system, it is possible that storm events, floods, and/or other forces could also resuspend these sediments.

5.3.5 Pathways and Receptors

The upper clay layer impedes the vertical migration of DNAPL, except in areas where the clay layer is breached. Known occurrences of DNAPL in the intermediate water- bearing zone appear to be limited, and the clay layers present within the intermediate zone further impede vertical DNAPL migration.

Potential human exposure to impacted groundwater at the CPA Site is minimal. The potential for the impacted groundwater at the site to be used as a potable water source is highly unlikely. Therefore, the most significant potential receptor for impacted groundwater is the Cooper River. Sentinel monitoring well data indicate the constituents in the intermediate zone are not reaching the Cooper River.

Presently there are sediments of concern which exist outside of the original contours of the sand blanket. Exposure of benthic organisms could occur in areas where sand blankets do not currently exist, or in areas where erosion of existing sand blankets might occur in the future. Most of the contaminated sediments were initially covered by sand blankets or soil filling during the construction of the Aquarium, the Tour Boat Dock, and the interim removal action for the Charlotte Street seep. Sections 2.4.1.1 2.4.2.1 and of the Problem Formulation report did show that the sand blanket was present in substantial amounts in the samples S-1, S-2, S-3, S-4, S-6, S-8 and SD-5, SD-6, and SD-8, respectively. While the evidence supporting the presence of the sand blanket is compelling, the total area represented by this sampling group is small when compared to the overall size of the sand blanket.

6.0 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

Land Use

The CPA Site includes the SCE&G Charlotte Street electrical substation, the former Calhoun Park, and the former Ansonborough Homes property (see Figure 1). The SCE&G property is currently used an electrical substation, and is expected to continue to be utilized for that purpose in the future. The former Calhoun Park area is now the site of a parking garage operated by the City of Charleston. The former Ansonborough Homes portion of the site is currently used as soccer fields on the southern portion, and additional commercial development is expected for the remaining northern area.

Adjacent properties to the CPA Site have been developed for commercial use. Immediately north of the CPA Site, directly across Charlotte Street, is an inter-modal transportation and storage facility. Bounding the site to the west along Washington Street are railroad lines. A mixture of light industrial, business and residential uses are present to the west of Washington Street. The Cooper River is approximately 500 feet east of the CPA Site. The Luden's property, located between the electrical substation and river, has been redeveloped as an IMAX theater, and a new retail/office building has been constructed in the eastern portion of the property. The area located south of Luden's and east of the parking garage includes NPS property, which is currently occupied by the City Aquarium and the tour boat facility for Fort Sumter. The Dockside Condominium complex is located to the south of the NPS area and east of the former Ansonborough Homes area.

Information utilized in the Baseline Risk Assessment (Black & Veatch, October 1994) was summarized in the original Feasibility Study (FS) Report (Fluor Daniel GTI, November 1997). Included was information from the U. S. Department of Housing and Urban Development (HUD, August 1996) and City of Charleston (City, July 1996) indicating that the CPA Site will be used for commercial purposes.

Groundwater Use

Potential human exposure to impacted groundwater at the CPA Site is minimal. Groundwater in the shallow and intermediate water-bearing zones has not been used for drinking water purposes in Charleston since the early 1800s. Future redevelopment of the CPA Site and adjacent properties as a residential area with on-site groundwater use is not envisioned and highly unlikely.

Resource Use

Sediments within the Cooper River are currently utilized as a habitat for benthic organisms, and the sediments are expected to continue to be utilized as a habitat in the future. Therefore, this resource use has received consideration in the assessment of potential ecological risks.

7.0 SUMMARY OF SITE RISKS

7.1 Human Health Baseline Risk Assessment

The baseline risk assessment estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies the constituents and exposure pathways that need to be addressed by the remedial action. The initial ROD for the CPA Site (EPA, September 1998) presents the results of the baseline risk assessment, which are summarized below. For specific details of risk, see Appendix C which includes the entire Risk Assessment for OU#1 for reference purposes.

Findings of the Baseline Risk Assessment (Black & Veatch, October 1994) indicate that the potential carcinogenic risks associated with exposure to intermediate groundwater by a hypothetical child or adult resident exceed the EPA target risk range of 10-4 to 10-6. Similarly, potential noncarcinogenic risks associated with exposure to intermediate groundwater by a hypothetical child or adult resident exceed a hazard index of 1.0. However, information from government agencies (City, July 1996 and HUD, August 1996) indicate that the CPA Site will be used for commercial purposes. Therefore, development of Remedial Action Objectives (RAOs) based on the calculated potential risks from hypothetical residential exposure scenarios provides a conservatively protective approach to groundwater. The risk from human exposure to sediment was not evaluated because human exposure to sediment is considered to be unlikely.

For intermediate groundwater, the response action selected in this Record of Decision is necessary to protect the public health and environment from actual or threatened releases of hazardous substances into the environment.

7.2 Ecological Risk Assessment

Based on the findings presented in the Interim Report on Ecological Risk Assessment (ERA), Process Step 3: Problem Formulation, Sediment and Surface Water Characterization (Godfrey and Associates, April 2002), surface water has been eliminated as a medium of concern for both the former Charlotte Street seep and brick archway areas.

Final COPCs and specific areas of potential concern were established for sediments in the problem formulation step of the ERA. Hazard quotients (HQs) for the COPCs are summarized in Tables 5-6 and 5-7 for the Charlotte Street and brick archway areas, respectively. The final constituents of concern for the areas of interest include PAHs, with all other constituents being eliminated from further consideration.

Direct contact with PAH-impacted sediments was evaluated in the ERA as an ecological exposure pathway for benthic organisms (potential receptors). Several ecological benchmarks were considered, including hazard quotients based on equilibrium partitioning sediment guideline toxicity units (ESGTU-HQs) for PAHs.

The river shoreline from Charlotte Street southward to beyond the NPS tour boat facility has been redeveloped. Construction projects, such as the South Carolina aquarium, new NPS tour boat facility and River Walk portion of the Luden's development, have essentially covered a large portion of the impacted sediment areas. Approximately 70 percent of the area with ESGTU-HQs equal to or greater than one is covered by permanent structures and the existing sand blankets. Also, some near shore areas have been filled with soil and/ or concrete. These activities have reduced but not eliminated the direct contact pathway for ecological exposures.

The response action selected in this Record of Decision is necessary to protect the environment from actual or threatened releases of hazardous substances into the environment.

Table 5-6
Summary of Sediment Data and ESGTU Calculations
Charlotte Street Exposure Group
Calhoun Park Area Site

		Station S-1			Station S-2			Station S-3			Station S-4			Station S-5			Station S-6			Station S-7		
	$C_{oc, PAH}$ [1] (ug/g $_{oc}$)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)
2-Methylnaphthalene	447	62.3	U	2.90E-03	239	U	1.57E-02	67.3	U	2.47E-03	412	U	1.28E-02	76.7	U	2.77E-03	412	U	1.54E-02	68.8	U	2.75E-03
Acenapthene	491	6.2	U	2.63E-04	16700		1.00E+00	6.7	U	2.24E-04	8.2	U	2.32E-04	7.7	U	2.53E-04	166	U	5.63E-03	139	U	5.06E-03
Acenapthylene	452	12.6	U	5.81E-04	1930	U	1.26E-01	13.7	U	4.97E-04	16.8	U	5.16E-04	15.6	U	5.57E-04	332	U	1.22E-02	277	U	1.09E-02
Anthracene	594	4.2	U	1.47E-04	15400		7.63E-01	4.5	U	1.24E-04	188		4.40E-03	5.1	U	1.38E-04	110	U	3.09E-03	91.7	U	2.76E-03
Benzo(a)anthracene	841	341.9		8.47E-03	13130		4.59E-01	101.2		1.97E-03	420.5		6.94E-03	150.2		2.88E-03	699.2		1.39E-02	2012		4.27E-02
Benzo(a)pyrene	965	315		6.80E-03	15700		4.79E-01	114		1.94E-03	615		8.85E-03	151		2.52E-03	1030		1.78E-02	2730		5.05E-02
Benzo(b)fluoranthene	979	287		6.11E-03	10500		3.15E-01	106		1.77E-03	392		5.56E-03	128		2.11E-03	632		1.08E-02	2040		3.72E-02
Benzo(g,h,i)perylene	1095	96		1.83E-03	733	U	1.97E-02	43		6.44E-04	31.8	U	4.03E-04	49		7.22E-04	126	U	1.92E-03	888		1.45E-02
Benzo(k)fluoranthene	981	108		2.29E-03	3860		1.16E-01	39		6.52E-04	142		2.01E-03	44		7.23E-04	28.2	U	4.79E-04	750		1.37E-02
Carbazole	349	62.3	U	3.72E-03	239	U	2.01E-02	67.3	U	3.16E-03	412	U	1.64E-02	76.7	U	3.54E-03	412	U	1.97E-02	68.8	U	3.52E-03
Chrysene	844	330		8.15E-03	14500		5.05E-01	112		2.18E-03	488		8.03E-03	158		3.02E-03	765		1.51E-02	2080		4.40E-02
Dibenzo(a,h)anthracene	1123	1.9	U	3.52E-05	290	U	7.60E-03	2	U	2.92E-05	12.5	U	1.55E-04	2.3	U	3.30E-05	50	U	7.42E-04	41.7	U	6.63E-04
Fluoranthene	707	1050		3.09E-02	71900		2.99E+00	367		8.51E-03	1480		2.91E-02	500		1.14E-02	2680		6.32E-02	9580		2.42E-01
Fluorene	538	1.3	U	5.03E-05	203	U	1.11E-02	1.4	U	4.27E-05	1.8	U	4.65E-05	1.6	U	4.80E-05	35	U	1.08E-03	1280		4.25E-02
Indeno(1,2,3-cd)pyrene	1115	177		3.31E-03	6960		1.84E-01	63		9.26E-04	330		4.11E-03	79		1.14E-03	71.5	U	1.07E-03	1370		2.19E-02
Naphthalene	385	0.38	U	2.06E-05	965	U	7.37E-02	105.1		4.48E-03	8.2	U	2.96E-04	7.9		3.31E-04	166	U	7.19E-03	354.2		1.64E-02
Phenanthrene	596	83		2.90E-03	56800		2.80E+00	84		2.31E-03	245		5.71E-03	163		4.41E-03	1560		4.36E-02	6560		1.97E-01
Pyrene	697	626		1.87E-02	70300		2.97E+00	200		4.70E-03	940		1.87E-02	272		6.29E-03	1760		4.21E-02	5960		1.53E-01
Totals [4]		3565		0.097	300349		12.855	1497		0.037	6144		0.124	1888		0.043	11035		0.275	36291		0.900

	Station S-1	Station S-2	Station S-3	Station S-4	Station S-5	Station S-6	Station S-7
F_{OC}(g_{oc} / $g_{sediment}$)	0.048	0.034	0.061	0.072	0.062	0.060	0.056
ESV HQs [5]	2	178	< 1	4	1	7	22
TEC HQs [6]	< 1	30	< 1	< 1	< 1	< 1	2

	Station S-1	Station S-2	Station S-3	Station S-4	Station S-5	Station S-6	Station S-7
TOTAL ESGTU (using 0.95 correction factor of 7.820)	<1	101	<1	<1	<1	2	7
TOTAL ESGTU (using 0.90 correction factor of 5.910)	<1	76	<1	<1	<1	2	5
TOTAL ESGTU (using 0.80 correction factor of 4.790)	<1	62	<1	<1	<1	1	4
TOTAL ESGTU (using 0.50 correction factor of 2.195)	<1	28	<1	<1	<1	<1	2

Table 5-6
Summary of Sediment Data and ESGTU Calculations
Charlotte Street Exposure Group
Calhoun Park Area Site

	$C_{oc, PAH}$ [1] (ug/g $_{oc}$)	Station S-8 Result [2] (ug/kg)		Station S-8 ESGTU [3] (unitless)	Station S-9 Result [2] (ug/kg)		Station S-9 ESGTU [3] (unitless)	Station S-10 Result [2] (ug/kg)		Station S-10 ESGTU [3] (unitless)	Station S-11 Result [2] (ug/kg)		Station S-11 ESGTU [3] (unitless)	Station S-12 Result [2] (ug/kg)		Station S-12 ESGTU [3] (unitless)	Station S-13 Result [2] (ug/kg)		Station S-13 ESGTU [3] (unitless)	Station S-14 Result [2] (ug/kg)		Station S-14 ESGTU [3] (unitless)
2-Methylnaphthalene	447	223	U	6.16E-03	80.5	U	2.43E-03	100	U	2.31E-03	114	U	2.04E-03	114	U	2.90E-03	110	U	2.44E-03	110	U	3.00E-03
Acenapthene	491	90	U	2.26E-03	8	U	2.20E-04	10	U	2.10E-04	11	U	1.79E-04	11	U	2.55E-04	11	U	2.22E-04	11	U	2.73E-04
Acenapthylene	452	180	U	4.92E-03	16.3	U	4.87E-04	20.3	U	4.63E-04	23	U	4.07E-04	23	U	5.78E-04	22	U	4.82E-04	22	U	5.94E-04
Anthracene	594	59.5	U	1.24E-03	5.4	U	1.23E-04	6.7	U	1.16E-04	8	U	1.08E-04	8	U	1.53E-04	7	U	1.17E-04	7	U	1.44E-04
Benzo(a)anthracene	841	360		5.28E-03	296.3		4.76E-03	1.3	U	1.59E-05	1.5	U	1.43E-05	57		7.70E-04	122		1.44E-03	1.4	U	2.03E-05
Benzo(a)pyrene	965	459		5.87E-03	324		4.54E-03	0.9	U	9.61E-06	1	U	8.29E-05	80		9.42E-04	200		2.05E-03	1	U	1.26E-05
Benzo(b)fluoranthene	979	324		4.09E-03	276		3.81E-03	1.8	U	1.90E-05	2	U	1.63E-05	50		5.80E-04	110		1.11E-03	2	U	2.49E-05
Benzo(g,h,i)perylene	1095	68.4	U	7.71E-04	120		1.48E-03	7.6	U	7.16E-05	9	U	6.68E-05	9	U	9.34E-05	8	U	7.23E-05	8	U	8.91E-05
Benzo(k)fluoranthene	981	15.3	U	1.93E-04	105		1.45E-03	1.8	U	1.89E-05	2	U	1.63E-05	2	U	2.32E-05	40		4.04E-04	2	U	2.49E-05
Carbazole	349	223	U	7.89E-03	80.5	U	3.12E-03	100	U	2.95E-03	114	U	2.61E-03	114	U	3.71E-03	110	U	3.12E-03	110	U	3.84E-03
Chrysene	844	405		5.92E-03	259		4.15E-03	1.5	U	1.83E-05	2	U	1.90E-05	60		8.08E-04	160		1.88E-03	2	U	2.89E-05
Dibenzo(a,h)anthracene	1123	27	U	2.97E-04	2.4	U	2.89E-05	3	U	2.75E-05	3	U	2.14E-05	3	U	3.04E-05	3	U	2.64E-05	3	U	3.26E-05
Fluoranthene	707	1180		2.06E-02	1200		2.29E-02	2.1	U	3.06E-05	2	U	2.26E-05	170		2.73E-03	540		7.56E-03	2	U	3.46E-05
Fluorene	538	18.9	U	4.34E-04	1.7	U	4.27E-05	2.1	U	4.02E-05	2	U	2.97E-05	2	U	4.22E-05	2	U	3.68E-05	2	U	4.53E-05
Indeno(1,2,3-cd)pyrene	1115	38.6	U	4.27E-04	173		2.10E-03	4.2	U	3.88E-05	5	U	3.59E-05	50		5.10E-04	120		1.07E-03	5	U	5.47E-05
Naphthalene	385	90	U	2.89E-03	0.46	U	1.61E-05	8.2		2.20E-04	11	U	2.29E-04	11	U	3.25E-04	11	U	2.83E-04	11	U	3.48E-04
Phenanthrene	596	162		3.36E-03	337		7.64E-03	6.4	U	1.11E-04	7	U	9.40E-05	7	U	1.33E-04	130		2.16E-03	7	U	1.43E-04
Pyrene	697	909		1.61E-02	605		1.17E-02	2.7	U	3.99E-05	3	U	3.44E-05	120		1.96E-03	330		4.69E-03	3	U	5.25E-05
Totals [4]		4833		0.089	3891		0.071	281		0.007	321		0.006	891		0.017	2036		0.029	309		0.009

	Station S-8	Station S-9	Station S-10	Station S-11	Station S-12	Station S-13	Station S-14
F_{OC}(g_{oc} / $g_{sediment}$)	0.081	0.074	0.097	0.125	0.088	0.101	0.082
ESV HQs [5]	3	2	< 1	< 1	< 1	1	< 1
TEC HQs [6]	< 1	< 1	< 1	< 1	< 1	< 1	< 1

	Station S-8	Station S-9	Station S-10	Station S-11	Station S-12	Station S-13	Station S-14
TOTAL ESGTU (using 0.95 correction factor of 7.820)	<1	<1	<1	<1	<1	<1	<1
TOTAL ESGTU (using 0.90 correction factor of 5.910)	<1	<1	<1	<1	<1	<1	<1
TOTAL ESGTU (using 0.80 correction factor of 4.790)	<1	<1	<1	<1	<1	<1	<1
TOTAL ESGTU (using 0.50 correction factor of 2.195)	<1	<1	<1	<1	<1	<1	<1

Table 5-6
Summary of Sediment Data and ESGTU Calculations
Charlotte Street Exposure Group
Calhoun Park Area Site

	$C_{oc,\ PAH}$ [1]	Station S-15			Station S-16			Station S-17			Station S-18			Station S-19			Station S-20			Station S-21		
	(ug/g $_{oc}$)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)
2-Methylnaphthalene	447	33	U	8.20E-04	127	U	2.00E-03	114	U	2.63E-03	97.1	U	2.29E-03	114	U	2.68E-03	78.6	U	1.79E-03	128	U	2.63E-03
Acenapthene	491	3.3	U	7.47E-05	13	U	1.86E-04	11	U	2.31E-04	9.7	U	2.08E-04	11	U	2.36E-04	364		7.56E-03	13	U	2.43E-04
Acenapthylene	452	6.7	U	1.65E-04	26	U	4.05E-04	23	U	5.25E-04	19.7	U	4.59E-04	23	U	5.36E-04	159	U	3.59E-03	26	U	5.28E-04
Anthracene	594	2.2	U	4.12E-05	8	U	9.48E-05	8	U	1.39E-04	315		5.58E-03	8	U	1.42E-04	221		3.80E-03	8	U	1.24E-04
Benzo(a)anthracene	841	29.6		3.91E-04	1.7	U	1.42E-05	44		5.39E-04	195		2.44E-03	1.5	U	1.88E-05	523.3		6.35E-03	1.7	U	1.85E-05
Benzo(a)pyrene	965	29		3.34E-04	1	U	7.30E-06	50		5.34E-04	297		3.24E-03	1	U	1.09E-05	833		8.81E-03	1	U	9.51E-06
Benzo(b)fluoranthene	979	25		2.84E-04	2	U	1.44E-05	40		4.21E-04	188		2.02E-03	2	U	2.15E-05	562		5.86E-03	2	U	1.87E-05
Benzo(g,h,i)perylene	1095	9		9.13E-05	10	U	6.43E-05	20		1.88E-04	97		9.32E-04	9	U	8.65E-05	293		2.73E-03	10	U	8.38E-05
Benzo(k)fluoranthene	981	9		1.02E-04	2	U	1.44E-05	20		2.10E-04	71		7.62E-04	2	U	2.15E-05	198		2.06E-03	2	U	1.87E-05
Carbazole	349	33	U	1.05E-03	127	U	2.56E-03	114	U	3.37E-03	97.1	U	2.93E-03	114	U	3.44E-03	78.6	U	2.30E-03	128	U	3.36E-03
Chrysene	844	30		3.95E-04	2	U	1.67E-05	40		4.89E-04	221		2.76E-03	2	U	2.49E-05	586		7.08E-03	2	U	2.17E-05
Dibenzo(a,h)anthracene	1123	1	U	9.89E-06	4	U	2.51E-05	3	U	2.75E-05	2.9	U	2.72E-05	3	U	2.81E-05	23.8	U	2.16E-04	4	U	3.27E-05
Fluoranthene	707	100		1.57E-03	3	U	2.99E-05	130		1.90E-03	688		1.02E-02	2	U	2.98E-05	1850		2.67E-02	3	U	3.89E-05
Fluorene	538	0.7	U	1.45E-05	3	U	3.93E-05	2	U	3.83E-05	2.1	U	4.11E-05	2	U	3.91E-05	16.7	U	3.17E-04	3	U	5.12E-05
Indeno(1,2,3-cd)pyrene	1115	17		1.69E-04	5	U	3.16E-05	30		2.77E-04	103		9.72E-04	5	U	4.72E-05	538		4.92E-03	5	U	4.11E-05
Naphthalene	385	2385		6.88E-02	13	U	2.38E-04	0.69	U	1.85E-05	9.7	U	2.65E-04	11	U	3.01E-04	79.3	U	2.10E-03	109.2		2.60E-03
Phenanthrene	596	44		8.20E-04	8	U	9.45E-05	40		5.92E-04	185		3.27E-03	7	U	1.24E-04	840		1.44E-02	8	U	1.23E-04
Pyrene	697	50		7.97E-04	3	U	3.03E-05	70		1.04E-03	424		6.40E-03	20		3.02E-04	1100		1.61E-02	3	U	3.95E-05
Totals [4]		2808		0.076	359		0.006	760		0.013	3022		0.045	338		0.008	8344		0.117	457		0.010

	Station S-15	Station S-16	Station S-17	Station S-18	Station S-19	Station S-20	Station S-21
F_{OC}(g_{oc} / $g_{sediment}$)	0.090	0.142	0.097	0.095	0.095	0.098	0.109
ESV HQs [5]	2	< 1	< 1	2	< 1	5	< 1
TEC HQs [6]	< 1	< 1	< 1	< 1	< 1	< 1	< 1

	Station S-15	Station S-16	Station S-17	Station S-18	Station S-19	Station S-20	Station S-21
TOTAL ESGTU (using 0.95 correction factor of 7.820)	<1	<1	<1	<1	<1	<1	<1
TOTAL ESGTU (using 0.90 correction factor of 5.910)	<1	<1	<1	<1	<1	<1	<1
TOTAL ESGTU (using 0.80 correction factor of 4.790)	<1	<1	<1	<1	<1	<1	<1
TOTAL ESGTU (using 0.50 correction factor of 2.195)	<1	<1	<1	<1	<1	<1	<1

Table 5-6
Summary of Sediment Data and ESGTU Calculations
Charlotte Street Exposure Group
Calhoun Park Area Site

		Station S-22			Station S-23			Station S-24			Station S-25			Station S-26			Station S-27			Station S-28		
	$C_{oc,\,PAH}$ [1] (ug/g $_{oc}$)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)
2-Methylnaphthalene	447	118	U	2.36E-03	94.3	U	2.85E-03	114	U	2.58E-03	110	U	3.37E-03	82.5	U	2.31E-03	94.3	U	2.48E-03	67.3	U	2.01E-03
Acenapthene	491	12	U	2.18E-04	9.4	U	2.59E-04	11	U	2.26E-04	11	U	3.07E-04	8.2	U	2.09E-04	9.4	U	2.25E-04	6.7	U	1.82E-04
Acenapthylene	452	24	U	4.74E-04	19.1	U	5.71E-04	23	U	5.14E-04	22	U	6.67E-04	16.8	U	4.65E-04	19.1	U	4.97E-04	13.7	U	4.04E-04
Anthracene	594	8	U	1.20E-04	6.3	U	1.43E-04	8	U	1.36E-04	7	U	1.61E-04	5.5	U	1.16E-04	6.3	U	1.25E-04	4.5	U	1.01E-04
Benzo(a)anthracene	841	1.5	U	1.59E-05	117.1		1.88E-03	1.5	U	1.80E-05	1.4	U	2.28E-05	1.08	U	1.61E-05	1.23	U	1.72E-05	0.88	U	1.40E-05
Benzo(a)pyrene	965	1	U	9.25E-06	174		2.44E-03	1	U	1.05E-05	1	U	1.42E-05	0.8	U	1.04E-05	23		2.80E-04	0.6	U	8.29E-05
Benzo(b)fluoranthene	979	2	U	1.82E-05	123		1.70E-03	2	U	2.06E-05	2	U	2.80E-05	1.5	U	1.92E-05	1.7	U	2.04E-05	1.2	U	1.63E-05
Benzo(g,h,i)perylene	1095	9	U	7.34E-05	7.1	U	8.76E-05	9	U	8.30E-05	8	U	1.00E-04	6.2	U	7.08E-05	7.1	U	7.63E-05	5.1	U	6.21E-05
Benzo(k)fluoranthene	981	2	U	1.82E-05	49		6.75E-04	2	U	2.06E-05	2	U	2.79E-05	1.5	U	1.91E-05	1.7	U	2.04E-05	1.2	U	1.63E-05
Carbazole	349	118	U	3.02E-03	94.3	U	3.65E-03	114	U	3.30E-03	110	U	4.32E-03	82.5	U	2.95E-03	94.3	U	3.18E-03	67.3	U	2.57E-03
Chrysene	844	2	U	2.12E-05	149		2.39E-03	2	U	2.39E-05	2	U	3.25E-05	1.2	U	1.78E-05	1.4	U	1.95E-05	1	U	1.58E-05
Dibenzo(a,h)anthracene	1123	4	U	3.18E-05	2.9	U	3.49E-05	3	U	2.70E-05	3	U	3.66E-05	2.5	U	2.78E-05	2.9	U	3.04E-05	2	U	2.37E-05
Fluoranthene	707	2	U	2.53E-05	414		7.91E-03	2	U	2.86E-05	2	U	3.88E-05	1.8	U	3.18E-05	34		5.66E-04	1.4	U	2.64E-05
Fluorene	538	2	U	3.32E-05	2	U	5.02E-05	2	U	3.76E-05	2	U	5.09E-05	1.8	U	4.18E-05	2	U	4.37E-05	1.4	U	3.47E-05
Indeno(1,2,3-cd)pyrene	1115	5	U	4.00E-05	94		1.14E-03	5	U	4.53E-05	5	U	6.14E-05	3.5	U	3.92E-05	4	U	4.22E-05	2.9	U	3.47E-05
Naphthalene	385	12	U	2.78E-04	9.4	U	3.30E-04	0.72	U	1.89E-05	0.67	U	2.38E-05	0.5	U	1.62E-05	0.63	U	1.93E-05	0.41	U	1.42E-05
Phenanthrene	596	8	U	1.20E-04	111		2.52E-03	7	U	1.19E-04	7	U	1.61E-04	5.2	U	1.09E-04	6	U	1.18E-04	4.3	U	9.62E-05
Pyrene	697	3	U	3.84E-05	320		6.20E-03	3	U	4.35E-05	3	U	5.90E-05	2.2	U	3.95E-05	2.6	U	4.39E-05	1.8	U	3.44E-05
Totals [4]		334		0.007	1796		0.035	310		0.007	299		0.009	226		0.007	312		0.008	184		0.006

F_{OC}(g_{oc} / $g_{sediment}$)	0.112	0.074	0.099	0.073	0.080	0.085	0.075
ESV HQs [5]	< 1	1	< 1	< 1	< 1	< 1	< 1
TEC HQs [6]	< 1	< 1	< 1	< 1	< 1	< 1	< 1

TOTAL ESGTU (using 0.95 correction factor of 7.820)	<1	<1	<1	<1	<1	<1	<1
TOTAL ESGTU (using 0.90 correction factor of 5.910)	<1	<1	<1	<1	<1	<1	<1
TOTAL ESGTU (using 0.80 correction factor of 4.790)	<1	<1	<1	<1	<1	<1	<1
TOTAL ESGTU (using 0.50 correction factor of 2.195)	<1	<1	<1	<1	<1	<1	<1

(1) - Critical Concentration of PAH in sediment taken from EPA (2000).
(2) - Non-detected results are shown as 1/10th the sample specific detection limit.
(3) - ESGTU is the equilibrium partitioning sediment guideline toxic unit. First, sediment PAH is normalized to ug PAH per g organic carbon using sample specific F_{oc}.
Then the resultant value is divided by the $C_{oc,PAH}$ to obtain the ESGTU.
(4) - Total PAHs calculated using 1/10th the detection limit for non-detected results. The ESGTUs for each specific PAH are summed to obtain a total ESGTU for each station.
Total ESGTU is essentially a station-specific HQ.
(5) - ESV HQ = Total PAHs / 1684 : These HQs were presented in the Draft Problem Formulation and have been updated to use 1/10th detection limit as a surrogate for non-detects.
(6) - TEC HQc = Total PAHs (normalized to ug / g organic carbon) / 290 ; These values were presented in the Draft Problem Formulation and are updated to use corrected F_{oc} data.

Table 5-7
Summary of Sediment Data and ESGTU Calculations
Brick Archway Exposure Group
Calhoun Park Area Site

	$C_{oc, PAH}$ [1]	1997 Addendum SD-01			1997 Addendum SD-02			1997 Addendum SD-03			1997 Addendum SD-04			1997 Addendum SD-05			1997 Addendum SD-06			1997 Addendum SD-07		
	(ug/g $_{oc}$)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)
2-Methylnaphthalene	447	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00
Acenapthene	491	430	U	1.03E-02	19	U	4.55E-04	340	U	8.15E-03	230		5.51E-03	330	U	7.91E-03	240	U	5.75E-03	170	U	4.07E-03
Acenapthylene	452	430	U	1.12E-02	105		2.73E-03	340	U	8.85E-03	20	U	5.21E-04	330	U	8.59E-03	240	U	6.25E-03	170	U	4.42E-03
Anthracene	594	180		3.57E-03	75		1.49E-03	260		5.15E-03	57		1.13E-03	140		2.77E-03	30	U	5.94E-04	24		4.75E-04
Benzo(a)anthracene	841	750		1.05E-02	190		2.66E-03	1100		1.54E-02	68		9.51E-04	470		6.57E-03	880		1.23E-02	38		5.32E-04
Benzo(a)pyrene	965	910		1.11E-02	220		2.68E-03	1400		1.71E-02	74		9.02E-04	710		8.66E-03	940		1.15E-02	54		6.58E-04
Benzo(b)fluoranthene	979	1000		1.20E-02	320		3.85E-03	1300		1.56E-02	140		1.68E-03	1100		1.32E-02	980		1.18E-02	84		1.01E-03
Benzo(g,h,i)perylene	1095	1600		1.72E-02	280		3.01E-03	2400		2.58E-02	130		1.40E-03	1200		1.29E-02	1600		1.72E-02	8.3	U	8.92E-05
Benzo(k)fluoranthene	981	320		3.84E-03	99		1.19E-03	480		5.76E-03	31		3.72E-04	440		5.28E-03	380		4.56E-03	39		4.68E-04
Carbazole	349	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00
Chrysene	844	2300		3.21E-02	6.9	U	9.62E-05	3200		4.46E-02	170		2.37E-03	2900		4.04E-02	3200		4.46E-02	75		1.05E-03
Dibenzo(a,h)anthracene	1123	4200		4.40E-02	1.4	U	1.47E-05	7200		7.54E-02	320		3.35E-03	3300		3.46E-02	4600		4.82E-02	4.9	U	5.13E-05
Fluoranthene	707	1500		2.50E-02	470		7.82E-03	1500		2.50E-02	190		3.16E-03	1500		2.50E-02	1200		2.00E-02	71		1.18E-03
Fluorene	538	250		5.47E-03	75		1.64E-03	520		1.14E-02	44		9.62E-04	140		3.05E-03	190		4.15E-03	56		1.22E-03
Indeno(1,2,3-cd)pyrene	1115	620		6.54E-03	160		1.69E-03	1900		2.00E-02	42		4.43E-04	1000		1.05E-02	550		5.80E-03	260		2.74E-03
Naphthalene	385	430	U	1.31E-02	19	U	5.81E-04	340	U	1.04E-02	20	U	6.11E-04	2700		8.25E-02	240	U	7.33E-03	170	U	5.19E-03
Phenanthrene	596	430		8.49E-03	88		1.74E-03	1300		2.57E-02	4.8	U	9.47E-05	160		3.15E-03	300		5.92E-03	41	U	8.09E-04
Pyrene	697	2900		4.89E-02	600		1.01E-02	2300		3.88E-02	260		4.39E-03	960		1.62E-02	1700		2.87E-02	130		2.19E-03
Totals [4]		18250		0.263	2728		0 042	25880		0.353	1801		0.028	17380		0.281	17270		0.235	1395		0.026

	SD-01	SD-02	SD-03	SD-04	SD-05	SD-06	SD-07
F_{OC}(g_{oc} / $g_{sediment}$)	0 085	0.085	0.085	0 085	0.085	0.085	0.085
ESV HQs [5]	11	2	15	1	10	10	< 1
TEC HQs [6]	< 1	< 1	1	< 1	< 1	< 1	< 1

	SD-01	SD-02	SD-03	SD-04	SD-05	SD-06	SD-07
TOTAL ESGTU (using 0.95 correction factor of 7.820)	2	<1	3	<1	2	2	<1
TOTAL ESGTU (using 0.90 correction factor of 5.910)	2	<1	2	<1	2	1	<1
TOTAL ESGTU (using 0.80 correction factor of 4.790)	1	<1	2	<1	1	1	<1
TOTAL ESGTU (using 0.50 correction factor of 2.195)	<1	<1	<1	<1	<1	<1	<1

Table 5-7
Summary of Sediment Data and ESGTU Calculations
Brick Archway Exposure Group
Calhoun Park Area Site

		1997 Addendum SD-08			1997 Addendum SD-09			1997 Addendum SD-10			1997 Addendum SD-11			1997 Addendum SD-12			1997 Addendum SD-13			1997 Addendum SD-14		
	$C_{oc, PAH}$ [1] (ug/g $_{oc}$)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)	Result [2] (ug/kg)		ESGTU [3] (unitless)
2-Methylnaphthalene	447	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00
Acenapthene	491	2700		6.47E-02	180	U	4.31E-03	210	U	5.03E-03	30000		7.19E-01	450	U	1.08E-02	40000		9.58E-01	1600	U	3.83E-02
Acenapthylene	452	290	U	7.55E-03	180	U	4.69E-03	210	U	5.47E-03	7300		1.90E-01	450	U	1.17E-02	18000		4.69E-01	1600	U	4.16E-02
Anthracene	594	150		2.97E-03	68		1.35E-03	25		4.95E-04	7500		1.49E-01	41		8.12E-04	6500		1.29E-01	720		1.43E-02
Benzo(a)anthracene	841	1400		1.96E-02	740		1.04E-02	43		6.02E-04	9500		1.33E-01	94		1.31E-03	7200		1.01E-01	1800		2.52E-02
Benzo(a)pyrene	965	1600		1.95E-02	810		9.88E-03	67		8.17E-04	7500		9.14E-02	110		1.34E-03	5600		6.83E-02	2100		2.56E-02
Benzo(b)fluoranthene	979	1600		1.92E-02	610		9.73E-03	100		1.20E-03	6400		7.69E-02	170		2.04E-03	4200		5.05E-02	2100		2.52E-02
Benzo(g,h,i)perylene	1095	2500		2.69E-02	1500		1.72E-02	210		2.26E-03	10000		1.07E-01	27	U	2.90E-04	6800		7.31E-02	2700		2.90E-02
Benzo(k)fluoranthene	981	590		7.08E-03	300		3.60E-03	34		4.08E-04	2300		2.76E-02	48		5.76E-04	1600		1.92E-02	750		8.99E-03
Carbazole	349	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00
Chrysene	844	2300		3.21E-02	2800		3.90E-02	120		1.57E-03	34000		4.74E-01	273		3.81E-03	29000		4.04E-01	5900		9.62E-02
Dibenzo(a,h)anthracene	1123	7100		7.44E-02	4400		4.61E-02	5.9	U	6.18E-05	30000		3.14E-01	16	U	1.68E-04	27000		2.83E-01	9600		1.01E-01
Fluoranthene	707	1500		2.50E-02	1000		1.66E-02	110		1.83E-03	15000		2.50E-01	320		5.32E-03	12000		2.00E-01	2500		4.16E-02
Fluorene	538	480		1.05E-02	190		4.15E-03	53		1.16E-03	14000		3.06E-01	93		2.03E-03	13000		2.84E-01	160	U	3.50E-03
Indeno(1,2,3-cd)pyrene	1115	870		9.18E-03	1400		1.48E-02	104		1.10E-03	4100		4.33E-02	100		1.06E-03	3300		3.48E-02	1900		2.00E-02
Naphthalene	385	1400		4.28E-02	180	U	5.50E-03	190		5.81E-03	14000		4.28E-01	450	U	1.38E-02	14000		4.28E-01	1600	U	4.89E-02
Phenanthrene	596	550		1.09E-02	250		4.93E-03	50	U	9.87E-04	31000		6.12E-01	71		1.40E-03	25000		4.93E-01	1300		2.57E-02
Pyrene	697	3000		5.06E-02	1600		2.70E-02	310		5.23E-03	25000		4.22E-01	410		6.92E-03	19000		3.21E-01	3300		5.57E-02
Totals [4]		28030		0.423	16508		0.219	1842		0.034	247600		4.343	3123		0.063	232200		4.315	40630		0.600

F_{OC}(g_{oc} / $g_{sediment}$)	0 085	0.085	0.085	0.085	0.085	0.085	0.085
ESV HQs [5]	17	10	1	147	2	138	24
TEC HQs [6]	1	< 1	< 1	10	< 1	9	2

TOTAL ESGTU (using 0.95 correction factor of 7.820)	3	2	<1	34	<1	34	5
TOTAL ESGTU (using 0.90 correction factor of 5.910)	2	1	<1	26	<1	26	4
TOTAL ESGTU (using 0.80 correction factor of 4.790)	2	1	<1	21	<1	21	3
TOTAL ESGTU (using 0.50 correction factor of 2.195)	<1	<1	<1	10	<1	9	1

Table 5-7
Summary of Sediment Data and ESGTU Calculations
Brick Archway Exposure Group
Calhoun Park Area Site

		1997 Addendum SD-15			1997 Addendum SD-16			1997 Addendum SD-17			1997 Addendum SD-18			1997 Addendum SD-19			1993 RI SD-10			1997 Addendum SD-12		
	$C_{oc, PAH}$ [1]	Result [2]		ESGTU [3]	Result [2]		ESGTU [3]	Result [2]		ESGTU [3]	Result [2]		ESGTU [3]	Result [2]		ESGTU [3]	Result [2]		ESGTU [3]	Result [2]		ESGTU [3]
	(ug/g $_{oc}$)	(ug/kg)		(unitless)	(ug/kg)		(unitless)	(ug/kg)		(unitless)	(ug/kg)		(unitless)	(ug/kg)		(unitless)	(ug/kg)		(unitless)	(ug/kg)		(unitless)
2-Methylnaphthalene	447	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	6000		2.56E-01	110	U	9.08E-03
Acenapthene	491	270	U	6.47E-03	450	U	1.08E-02	280	U	6.71E-03	250	U	5.99E-03	350	U	8.39E-03	2400		9.33E-02	110	U	8.27E-03
Acenapthylene	452	270	U	7.03E-03	450	U	1.17E-02	950		2.47E-02	250	U	6.51E-03	350	U	9.11E-03	400		1.69E-02	110	U	8.98E-03
Anthracene	594	280		5.55E-03	120		2.38E-03	740		1.47E-02	67		1.33E-03	140		2.77E-03	1800		5.78E-02	110	U	6.83E-03
Benzo(a)anthracene	841	1900		2.66E-02	140		1.96E-03	860		1.20E-02	1000		1.40E-02	610		8.53E-03	2400		5.45E-02	220		9.55E-03
Benzo(a)pyrene	965	2000		2.44E-02	180		2.19E-03	920		1.12E-02	1200		1.46E-02	790		9.63E-03	1200		2.37E-02	140		5.35E-03
Benzo(b)fluoranthene	979	1900		2.28E-02	250		3.00E-03	720		8.65E-03	1200		1.44E-02	850		1.02E-02	1900		3.70E-02	230		8.67E-03
Benzo(g,h,i)perylene	1095	3200		3.44E-02	830		8.92E-03	1100		1.18E-02	1900		2.04E-02	1300		1.40E-02	430		7.49E-03	110	U	3.71E-03
Benzo(k)fluoranthene	981	680		8.15E-03	100		1.20E-03	300		3.60E-03	410		4.92E-03	350		4.20E-03	180	U	3.50E-03	110	U	4.14E-03
Carbazole	349	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	180	U	9.84E-03	110	U	1.16E-02
Chrysene	844	7200		1.00E-01	71		9.90E-04	3200		4.46E-02	4200		5.85E-02	2700		3.76E-02	2400		5.43E-02	210		9.18E-03
Dibenzo(a,h)anthracene	1123	9200		9.64E-02	16	U	1.68E-04	4200		4.40E-02	5600		5.87E-02	3800		3.98E-02	180	U	3.06E-03	110	U	3.61E-03
Fluoranthene	707	2400		3.99E-02	320		5.32E-03	1200		2.00E-02	1000		1.66E-02	910		1.51E-02	4200		1.13E-01	220		1.15E-02
Fluorene	538	350		7.65E-03	81		1.77E-03	870		1.90E-02	190		4.15E-03	200		4.37E-03	2300		8.16E-02	110	U	7.54E-03
Indeno(1,2,3-cd)pyrene	1115	1600		1.69E-02	870		9.18E-03	1200		1.27E-02	670		7.07E-03	1000		1.05E-02	640		1.10E-02	110	U	3.64E-03
Naphthalene	385	270	U	8.25E-03	450	U	1.38E-02	280	U	8.56E-03	250	U	7.64E-03	350	U	1.07E-02	3900		1.93E-01	110	U	1.05E-02
Phenanthrene	596	540		1.07E-02	95		1.88E-03	1700		3.36E-02	180		3.55E-03	260		5.13E-03	8400		2.69E-01	110	U	6.81E-03
Pyrene	697	3700		6.25E-02	410		6.92E-03	1800		3.04E-02	2000		3.38E-02	2200		3.71E-02	4400		1.20E-01	290		1.54E-02
Totals [4]		35760		0.478	4833		0.082	20320		0.306	20367		0.272	16160		0.227	43310		1.406	2630		0.144

F_{OC}(g_{oc} / $g_{sediment}$)	0.085	0.085	0.085	0.085	0.085	0.052	0.027
ESV HQs [5]	21	3	12	12	10	26	2
TEC HQs [6]	1	< 1	< 1	< 1	< 1	3	< 1

TOTAL ESGTU (using 0.95 correction factor of 7.820)	4	<1	2	2	2	11	1
TOTAL ESGTU (using 0.90 correction factor of 5.910)	3	<1	2	2	1	8	<1
TOTAL ESGTU (using 0.80 correction factor of 4.790)	2	<1	1	1	1	7	<1
TOTAL ESGTU (using 0.50 correction factor of 2.195)	1	<1	<1	<1	<1	3	<1

Table 5-7
Summary of Sediment Data and ESGTU Calculations
Brick Archway Exposure Group
Calhoun Park Area Site

	$C_{oc, PAH}$ [1] (ug/g $_{oc}$)	1993 RI SD-13 Result [2] (ug/kg)		1993 RI SD-13 ESGTU [3] (unitless)	1993 RI SD-14 Result [2] (ug/kg)		1993 RI SD-14 ESGTU [3] (unitless)	1993 RI SD-15 Result [2] (ug/kg)		1993 RI SD-15 ESGTU [3] (unitless)	1993 RI SD-16 Result [2] (ug/kg)		1993 RI SD-16 ESGTU [3] (unitless)	Killam Study S01-0.5 Result [2] (ug/kg)		Killam Study S01-0.5 ESGTU [3] (unitless)	Killam Study S02-1.5 Result [2] (ug/kg)		Killam Study S02-1.5 ESGTU [3] (unitless)	Killam Study S03-01 Result [2] (ug/kg)		Killam Study S03-01 ESGTU [3] (unitless)
2-Methylnaphthalene	447	41	U	3.70E-02	92	U	9.85E-03	160	U	1.02E-02	130	U	6.02E-03	NA		0.00E+00	58000		1.53E+00	NA		0.00E+00
Acenapthene	491	180		1.48E-01	92	U	8.97E-03	160	U	9.31E-03	130	U	5.48E-03	34		8.15E-04	75000		1.80E+00	2700		6.47E-02
Acenapthylene	452	330		2.94E-01	92	U	9.74E-03	160	U	1.01E-02	130	U	5.95E-03	9.2	U	2.39E-04	2100	U	5.47E-02	51	U	1.33E-03
Anthracene	594	230		1.56E-01	170		1.37E-02	160	U	7.70E-03	180		6.27E-03	2100		4.16E-02	62000		1.23E+00	2100		4.16E-02
Benzo(a)anthracene	841	850		4.08E-01	380		2.16E-02	160	U	5.44E-03	130	U	3.20E-03	300		4.20E-03	59000		8.25E-01	570		7.97E-03
Benzo(a)pyrene	965	1300		5.43E-01	380		1.88E-02	160	U	4.74E-03	130	U	2.79E-03	460		5.61E-03	38000		4.63E-01	580		7.07E-03
Benzo(b)fluoranthene	979	1600		6.59E-01	880		4.30E-02	160	U	4.67E-03	130	U	2.75E-03	540		6.49E-03	46000		5.53E-01	780		9.37E-03
Benzo(g,h,i)perylene	1095	440		1.62E-01	66		2.88E-03	160	U	4.17E-03	130	U	2.46E-03	160		1.72E-03	6300		6.77E-02	220		2.36E-03
Benzo(k)fluoranthene	981	870		3.58E-01	92	U	4.49E-03	160	U	4.66E-03	130	U	2.74E-03	320		3.84E-03	60000		7.20E-01	370		4.44E-03
Carbazole	349	41	U	4.74E-02	92	U	1.26E-02	160	U	1.31E-02	130	U	7.71E-03	NA		0.00E+00	7500		2.53E-01	NA		0.00E+00
Chrysene	844	740		3.54E-01	930		5.27E-02	160	U	5.42E-03	130	U	3.19E-03	350		4.88E-03	47000		6.55E-01	580		8.08E-03
Dibenzo(a,h)anthracene	1123	150		5.39E-02	92	U	3.92E-03	160	U	4.07E-03	130	U	2.40E-03	44		4.61E-04	37000		3.88E-01	56		5.87E-04
Fluoranthene	707	1600		9.13E-01	590		3.99E-02	160	U	6.47E-03	130		3.81E-03	1100		1.83E-02	98000		1.63E+00	1600		2.66E-02
Fluorene	538	41	U	3.07E-02	92	U	8.18E-03	160	U	8.50E-03	130	U	5.00E-03	250		5.47E-03	53000		1.16E+00	1200		2.62E-02
Indeno(1,2,3-cd)pyrene	1115	580		2.10E-01	150		6.44E-03	160	U	4.10E-03	130	U	2.41E-03	170		1.79E-03	5500		5.80E-02	140		1.48E-03
Naphthalene	385	41	U	4.29E-02	92	U	1.14E-02	160	U	1.19E-02	130	U	6.99E-03	9.6	U	2.93E-04	79000		2.41E+00	53	U	1.62E-03
Phenanthrene	596	230		1.56E-01	99		7.95E-03	160	U	7.67E-03	130	U	4.52E-03	240		4.74E-03	170000		3.36E+00	1900		3.75E-02
Pyrene	697	1200		6.94E-01	870		5.97E-02	160	U	6.56E-03	130	U	3.86E-03	1200		2.03E-02	110000		1.86E+00	1500		2.53E-02
Totals [4]		10464		5 265	5251		0.336	2880		0.129	2390		0.078	7287		0.121	1013400		19.005	14400		0.266

	1993 RI SD-13	1993 RI SD-14	1993 RI SD-15	1993 RI SD-16	Killam Study S01-0.5	Killam Study S02-1.5	Killam Study S03-01
F_{OC}(g_{oc} / $g_{sediment}$)	0.00248	0.021	0.035	0.0483	0.085	0.085	0.085
ESV HQs [5]	6	3	2	1	4	602	9
TEC HQs [6]	15	< 1	< 1	< 1	< 1	41	< 1

	1993 RI SD-13	1993 RI SD-14	1993 RI SD-15	1993 RI SD-16	Killam Study S01-0.5	Killam Study S02-1.5	Killam Study S03-01
TOTAL ESGTU (using 0.95 correction factor of 7.820)	41	3	1	<1	<1	149	2
TOTAL ESGTU (using 0.90 correction factor of 5.910)	31	2	<1	<1	<1	112	2
TOTAL ESGTU (using 0.80 correction factor of 4.790)	25	2	<1	<1	<1	91	1
TOTAL ESGTU (using 0.50 correction factor of 2.195)	12	<1	<1	<1	<1	42	<1

Table 5-7
Summary of Sediment Data and ESGTU Calculations
Brick Archway Exposure Group
Calhoun Park Area Site

	$C_{oc, PAH}$ [1] (ug/g $_{oc}$)	Killam Study S04-0.5 Result [2] (ug/kg)		Killam Study S04-0.5 ESGTU [3] (unitless)	Killam Study S05-0.5 Result [2] (ug/kg)		Killam Study S05-0.5 ESGTU [3] (unitless)	Killam Study S05-01 Result [2] (ug/kg)		Killam Study S05-01 ESGTU [3] (unitless)	Killam Study S07-01 Result [2] (ug/kg)		Killam Study S07-01 ESGTU [3] (unitless)	Killam Study S08-0.5 Result [2] (ug/kg)		Killam Study S08-0.5 ESGTU [3] (unitless)	Killam Study S09-0.5 Result [2] (ug/kg)		Killam Study S09-0.5 ESGTU [3] (unitless)	Killam Study S10-0.5 Result [2] (ug/kg)		Killam Study S10-0.5 ESGTU [3] (unitless)
2-Methylnaphthalene	447	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00
Acenapthene	491	7.5		1.80E-04	74		1.77E-03	1400		3.35E-02	830		1.99E-02	140		3.35E-03	34		8.15E-04	7.8	U	1.87E-04
Acenapthylene	452	9.5	U	2.47E-04	8.9	U	2.32E-04	360		9.37E-03	72	U	1.87E-03	19	U	4.95E-04	7.4	U	1.93E-04	8.7	U	2.26E-04
Anthracene	594	4300		8.52E-02	2600		5.15E-02	41	U	8.12E-04	40000		7.92E-01	4700		9.31E-02	3.9	U	7.72E-05	4.7	U	9.31E-05
Benzo(a)anthracene	841	480		6.71E-03	400		5.60E-03	19000		2.66E-01	9800		1.37E-01	990		1.38E-02	680		9.51E-03	190		2.66E-03
Benzo(a)pyrene	965	1000		1.22E-02	590		7.19E-03	18000		2.19E-01	9600		1.17E-01	1200		1.46E-02	1100		1.34E-02	270		3.29E-03
Benzo(b)fluoranthene	979	1200		1.44E-02	690		8.29E-03	15000		1.80E-01	12000		1.44E-01	2000		2.40E-02	1100		1.32E-02	270		3.24E-03
Benzo(g,h,i)perylene	1095	680		7.31E-03	230		2.47E-03	7400		7.95E-02	5100		5.48E-02	570		6.12E-03	400		4.30E-03	140		1.50E-03
Benzo(k)fluoranthene	981	730		8.75E-03	380		4.56E-03	11000		1.32E-01	5900		7.08E-02	910		1.09E-02	780		9.35E-03	190		2.28E-03
Carbazole	349	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00
Chrysene	844	610		8.50E-03	380		5.30E-03	9600		1.34E-01	7000		9.76E-02	1100		1.53E-02	1500		2.09E-02	170		2.37E-03
Dibenzo(a,h)anthracene	1123	93		9.74E-04	55		5.76E-04	2100		2.20E-02	1300		1.36E-02	130		1.36E-03	120		1.26E-03	33		3.46E-04
Fluoranthene	707	1600		2.66E-02	1200		2.00E-02	51000		8.49E-01	25000		4.16E-01	2200		3.66E-02	1100		1.83E-02	380		6.32E-03
Fluorene	538	16	U	3.50E-04	300		6.56E-03	4300		9.40E-02	1100		2.41E-02	740		1.62E-02	92		2.01E-03	15	U	3.28E-04
Indeno(1,2,3-cd)pyrene	1115	620		6.54E-03	260		2.74E-03	8900		9.39E-02	7200		7.60E-02	700		7.39E-03	360		3.80E-03	120		1.27E-03
Naphthalene	385	15		4.58E-04	9.2	U	2.81E-04	300		9.17E-03	510		1.56E-02	20	U	6.11E-04	12		3.67E-04	9	U	2.75E-04
Phenanthrene	596	370		7.30E-03	260		5.13E-03	12000		2.37E-01	14000		2.76E-01	1700		3.36E-02	1000		1.97E-02	230		4.54E-03
Pyrene	697	2100		3.54E-02	1400		2.36E-02	54000		9.11E-01	23000		3.86E-01	2600		4.39E-02	3100		5.23E-02	720		1.22E-02
Totals [4]		13831		0.221	8837		0.146	214401		3.271	162412		2.645	19719		0.321	11389		0.170	2758		0.041

	Killam Study S04-0.5	Killam Study S05-0.5	Killam Study S05-01	Killam Study S07-01	Killam Study S08-0.5	Killam Study S09-0.5	Killam Study S10-0.5
F_{OC}(g_{oc} / $g_{sediment}$)	0 085	0.085	0.085	0 085	0.085	0.085	0.085
ESV HQs [5]	8	5	127	96	12	7	2
TEC HQs [6]	< 1	< 1	9	7	< 1	< 1	< 1

	Killam Study S04-0.5	Killam Study S05-0.5	Killam Study S05-01	Killam Study S07-01	Killam Study S08-0.5	Killam Study S09-0.5	Killam Study S10-0.5
TOTAL ESGTU (using 0.95 correction factor of 7.820)	2	1	26	21	3	1	<1
TOTAL ESGTU (using 0.90 correction factor of 5.910)	1	<1	19	16	2	1	<1
TOTAL ESGTU (using 0.80 correction factor of 4.790)	1	<1	16	13	2	<1	<1
TOTAL ESGTU (using 0.50 correction factor of 2.195)	<1	<1	7	6	<1	<1	<1

Table 5-7
Summary of Sediment Data and ESGTU Calculations
Brick Archway Exposure Group
Calhoun Park Area Site

		Killam Study S11-0.5			Killam Study S12-0.5			Killam Study S13-0.5			Killam Study S14-0.5			Killam Study S15-0.5			Killam Study S16-0.5			Killam Study S17-0.5		
	$C_{oc, PAH}$ [1]	Result [2]		ESGTU [3]	Result [2]		ESGTU [3]	Result [2]		ESGTU [3]	Result [2]		ESGTU [3]	Result [2]		ESGTU [3]	Result [2]		ESGTU [3]	Result [2]		ESGTU [3]
	(ug/g $_{oc}$)	(ug/kg)		(unitless)	(ug/kg)		(unitless)	(ug/kg)		(unitless)	(ug/kg)		(unitless)	(ug/kg)		(unitless)	(ug/kg)		(unitless)	(ug/kg)		(unitless)
2-Methylnaphthalene	447	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00
Acenapthene	491	77		1.84E-03	67		1.61E-03	480		1.15E-02	660		1.58E-02	1200		2.88E-02	36		8.63E-04	5800		1.39E-01
Acenapthylene	452	15	U	3.90E-04	8.4	U	2.19E-04	15	U	3.90E-04	39	U	1.02E-03	38	U	9.89E-04	25		6.51E-04	63	U	1.64E-03
Anthracene	594	7.8	U	1.54E-04	5900		1.17E-01	2000		3.96E-02	1400		2.77E-02	350		6.93E-03	4.3	U	8.52E-05	37000		7.33E-01
Benzo(a)anthracene	841	1000		1.40E-02	900		1.26E-02	1200		1.68E-02	7200		1.01E-01	1700		2.38E-02	750		1.05E-02	10000		1.40E-01
Benzo(a)pyrene	965	1400		1.71E-02	1200		1.46E-02	1300		1.58E-02	4500		5.49E-02	1700		2.07E-02	1100		1.34E-02	9200		1.12E-01
Benzo(b)fluoranthene	979	2200		2.64E-02	1700		2.04E-02	1200		1.44E-02	4800		5.77E-02	1800		2.16E-02	1200		1.44E-02	12000		1.44E-01
Benzo(g,h,i)perylene	1095	770		8.27E-03	620		5.66E-03	540		5.80E-03	1400		1.50E-02	910		9.78E-03	470		5.05E-03	5100		5.48E-02
Benzo(k)fluoranthene	981	1000		1.20E-02	1100		1.32E-02	730		8.75E-03	3400		4.08E-02	1000		1.20E-02	770		9.23E-03	6800		8.15E-02
Carbazole	349	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00	NA		0.00E+00
Chrysene	844	1300		1.81E-02	770		1.07E-02	950		1.32E-02	5500		7.67E-02	1100		1.53E-02	870		1.21E-02	5100		7.11E-02
Dibenzo(a,h)anthracene	1123	150		1.57E-03	140		1.47E-03	140		1.47E-03	440		4.61E-03	210		2.20E-03	130		1.36E-03	1400		1.47E-02
Fluoranthene	707	500		8.32E-03	2100		3.49E-02	2400		3.99E-02	14000		2.33E-01	3900		6.49E-02	1400		2.33E-02	28000		4.66E-01
Fluorene	538	240		5.25E-03	360		7.87E-03	220		4.81E-03	430		9.40E-03	340		7.43E-03	180		3.94E-03	4400		9.62E-02
Indeno(1,2,3-cd)pyrene	1115	560		5.91E-03	900		9.50E-03	460		4.85E-03	1400		1.48E-02	750		7.91E-03	460		4.85E-03	5300		5.59E-02
Naphthalene	385	15	U	4.58E-04	8.7	U	2.66E-04	39		1.19E-03	40	U	1.22E-03	210		6.42E-03	21		6.42E-04	320		9.78E-03
Phenanthrene	596	2400		4.74E-02	580		1.14E-02	1100		2.17E-02	4200		8.29E-02	1800		3.55E-02	890		1.76E-02	5500		1.09E-01
Pyrene	697	3000		5.06E-02	3100		5.23E-02	2600		4.39E-02	27000		4.56E-01	5200		8.78E-02	1800		3.04E-02	27000		4.56E-01
Totals [4]		14635		0.218	19454		0.315	15374		0.244	76409		1.192	22208		0.352	10106		0.148	162983		2.584

F_{OC}(g_{oc} / $g_{sediment}$)	0.085	0 085	0.085	0.085	0.085	0.085	0.085
ESV HQs [5]	9	12	9	45	13	6	97
TEC HQs [6]	< 1	< 1	< 1	3	< 1	< 1	7

TOTAL ESGTU (using 0.95 correction factor of 7.820)	2	2	2	9	3	1	21
TOTAL ESGTU (using 0.90 correction factor of 5.910)	1	2	1	7	2	<1	16
TOTAL ESGTU (using 0.80 correction factor of 4.790)	1	2	1	6	2	<1	13
TOTAL ESGTU (using 0.50 correction factor of 2.195)	<1	<1	<1	3	< 1	<1	6

Table 5-7
Summary of Sediment Data and ESGTU Calculations
Brick Archway Exposure Group
Calhoun Park Area Site

	$C_{oc, PAH}$ [1]	Killam Study S18-1.5		Killam Study S19-0.5		Killam Study S20-0.5		PSI Study NPS-SD-03		PSI Study NPS-SD-04		PSI Study NPS-SD-05		PSI Study NPS-SD-10	
		Result [2]	ESGTU [3]	Result [2]	ESGTU [3]	Result [2]	ESGTU [3]	Result [2]	ESGTU [3]	Result [2]	ESGTU [3]	Result [2]	ESGTU [3]	Result [2]	ESGTU [3]
	(ug/g $_{oc}$)	(ug/kg)	(unitless)	(ug/kg)	(unitless)	(ug/kg)	(unitless)	(ug/kg)	(unitless)	(ug/kg)	(unitless)	(ug/kg)	(unitless)	(ug/kg)	(unitless)
2-Methylnaphthalene	447	1500	3.95E-02	NA	0.00E+00	580	1.53E-02	290	7.63E-03	280	7.37E-03	98	2.58E-03	560	1.47E-02
Acenapthene	491	30000	7.19E-01	1100	2.64E-02	11000	2.64E-01	3200	7.67E-02	1100	2.64E-02	600	1.44E-02	1900	4.55E-02
Acenapthylene	452	5500	1.43E-01	36	9.37E-04	1600	4.16E-02	3200	8.33E-02	680	1.77E-02	1100	2.86E-02	1900	4.95E-02
Anthracene	594	20000	3.96E-01	290	5.74E-03	8200	1.62E-01	4900	9.70E-02	1500	2.97E-02	1600	3.17E-02	5800	1.15E-01
Benzo(a)anthracene	841	38000	5.32E-01	1800	2.52E-02	14000	1.96E-01	12000	1.68E-01	3900	5.46E-02	4800	6.71E-02	11000	1.54E-01
Benzo(a)pyrene	965	27000	3.29E-01	1900	2.32E-02	7700	9.39E-02	7300	8.90E-02	2300	2.80E-02	3200	3.90E-02	5500	6.71E-02
Benzo(b)fluoranthene	979	32000	3.85E-01	1300	1.56E-02	7100	8.53E-02	54 U	6.49E-04	54 U	6.49E-04	54 U	6.49E-04	7100	8.53E-02
Benzo(g,h,i)perylene	1095	9700	1.04E-01	900	9.67E-03	2400	2.58E-02	2300	2.47E-02	960	1.03E-02	1200	1.29E-02	670	7.20E-03
Benzo(k)fluoranthene	981	41000	4.92E-01	1200	1.44E-02	5100	6.12E-02	54 U	6.48E-04	54 U	6.48E-04	54 U	6.48E-04	2800	3.36E-02
Carbazole	349	1100 U	3.71E-02	NA	0.00E+00	560 U	1.89E-02	590	1.99E-02	520	1.75E-02	200	6.74E-03	1300	4.38E-02
Chrysene	844	31000	4.32E-01	1500	2.09E-02	12000	1.67E-01	9400	1.31E-01	2900	4.04E-02	3900	5.44E-02	8000	1.12E-01
Dibenzo(a,h)anthracene	1123	2600	2.72E-02	210	2.20E-03	1300	1.36E-02	1000	1.05E-02	400	4.19E-03	430	4.50E-03	470	4.92E-03
Fluoranthene	707	60000	9.98E-01	3700	6.16E-02	25000	4.16E-01	14000	2.33E-01	5200	8.65E-02	5200	8.65E-02	13000	2.16E-01
Fluorene	538	12000	2.62E-01	260	5.69E-03	6100	1.33E-01	2400	5.25E-02	730	1.60E-02	740	1.62E-02	1800	3.94E-02
Indeno(1,2,3-cd)pyrene	1115	6500	6.86E-02	890	9.39E-03	2700	2.85E-02	3600	3.80E-02	1500	1.58E-02	1500	1.58E-02	1100	1.16E-02
Naphthalene	385	2800	8.56E-02	400	1.22E-02	980	2.99E-02	560	1.71E-02	380	1.16E-02	150	4.58E-03	750	2.29E-02
Phenanthrene	596	58000	1.14E+00	1100	2.17E-02	22000	4.34E-01	11000	2.17E-01	4200	8.29E-02	3300	6.51E-02	8400	1.66E-01
Pyrene	697	67000	1.13E+00	4800	8.10E-02	23000	3.88E-01	15000	2.53E-01	5500	9.28E-02	5700	9.62E-02	12000	2.03E-01
Totals [4]		445700	7.326	21386	0 336	151320	2.575	90848	1.520	32158	0.543	33826	0.548	84050	1.390

	Killam Study S18-1.5	Killam Study S19-0.5	Killam Study S20-0.5	PSI Study NPS-SD-03	PSI Study NPS-SD-04	PSI Study NPS-SD-05	PSI Study NPS-SD-10
F_{OC}(g_{oc} / $g_{sediment}$)	0.085	0.085	0.085	0.085	0.085	0.085	0.085
ESV HQs [5]	265	13	90	54	19	20	50
TEC HQs [6]	18	< 1	6	4	1	1	3
TOTAL ESGTU (using 0.95 correction factor of 7.820)	57	3	20	12	4	4	11
TOTAL ESGTU (using 0.90 correction factor of 5.910)	43	2	15	9	3	3	8
TOTAL ESGTU (using 0.80 correction factor of 4.790)	35	2	12	7	3	3	7
TOTAL ESGTU (using 0.50 correction factor of 2.195)	16	<1	6	3	1	1	3

(1) - Critical Concentration of PAH in sediment taken from EPA (2000).
(2) - Non-detected results are shown as 1/10th the sample specific detection limit.
(3) - ESGTU is the equilibrium partitioning sediment guideline toxic unit. First, sediment PAH is normal to ug PAH per g organic carbon using sample specific F_{oc}. Then the resultant value is divided by the $C_{oc, PAH}$ to obtain the ESGTU.
(4) - Total PAHs calculated using 1/10th the detection limit for non-detected results. The ESGTUs for each specific PAH are summed to obtain a total ESGTU for each station. Total ESGTU is essentially a station-specific HQ.
(5) - ESV HQ = Total PAHs / 1684 : These HQs were presented in the Draft Problem Formulation and have been updated to use 1/10th detection limit as a surrogate for non-detects.
(6) - TEC HQc = Total PAHs (normalized to ug / g organic carbon) / 290 ; These values were presented in the Draft Problem Formulation and are updated to use corrected F_{oc} data. The 290 threshold effects concentration (TEC) for total PAHs was taken from Swartz (1999).

Table 8-1
Remediation Goals
for Intermediate Groundwater

Parameter	Target Cleanup Goal (mg/l)
Volatile Organic Compounds:	
Benzene	0.005
Ethylbenzene	0.7
Toluene	1.0
Xylenes (total)	10.0
Semi-Volatile Organic Compounds:	
Benzo(a)pyrene	0.0002
Carbazole	0.005*
2,4-Dimethylphenol	0.7*
Naphthalene	1.5*

*Indicates cleanup goals derived from risk based calculations, rather than drinking water standards (MCLs)

8.0 REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) are site-specific goals for the remediation of specific media that are protective of both human health and ecological receptors. The remediation goals more specifically identify the target clean-up levels. The RAOs and remediation goals for groundwater within the intermediate zone and sediments are identified below. Development of RAOs or remediation goals for surface water is not necessary because surface water has been eliminated as a medium of concern.

8.1 Intermediate Groundwater

RAOs for groundwater within the intermediate zone were initially established in the EPA ROD for OU# 1 at the CPA Site dated September 1998. The objectives are the same as those established for shallow groundwater at the CPA Site and include:

- Removal or treatment of DNAPL to the maximum extent practicable;
- Containment of potentially non-restorable source areas;
- Restoration of aqueous constituent plumes; and
- Prevent exposure to groundwater having concentration above acceptable risk levels.

The remediation goals for intermediate groundwater are based on the target groundwater clean-up goals identified in the initial ROD for the CPA Site, and have been established for the constituents that are a concern in the intermediate groundwater zone. In addition, a clean-up goal of 10 mg/L has been established for xylenes(total) based on the current MCL.

Those clean-up goals were developed to be protective of a hypothetical on-site residential exposure scenario. Because no MCL exist for Carbazole, 2,4-Dimethylphenol, and Naphthalene, the cleanup goals were developed through risk based calculations for these constituents. The remediation goals are summarized in Table 8-1.

8.2 Sediments

RAOs for sediments were established in the Focused Feasibility Study For Sediments (MTR, May 2002b). The objectives were developed to be consistent with guidance presented in EPA’s Contaminated Sediment Management Strategy (EPA, April 1998) and include:

- Prevent exposure of benthic organisms to impacted sediments;
- Prevent the volume of PAH-contaminated sediment from increasing;
- Reduce the volume of PAH-contaminated sediment; and
- Prevent the erosion and provide for the long-term stability (reduce mobility) of impacted sediments.

Based on the RAOs identified above and information provided in the ERA (Godfrey and Associates, April 2002), the remedial goals for impacted sediments is to address (via exposure prevention or removal) those sediments with ESGTU-HQs that are one or greater for PAHs based on station-specific FOC data. The ESGTU-HQs will be calculated based on analytical results for the complete list of 34 PAHs specified in the draft ESGTU guidance. This represents a modification to the procedure for calculating ESGTUs used in the ERA and FFS. In prior evaluations, 18 of the 34 PAHs were analyzed, thus necessitating application of a 95th percentile correction factor per the ESGTU guidance. Analyzing for the complete list of 34 PAHs will reduce uncertainty, eliminate the need to apply the correction factor, and provide the most accurate definition of sediments of concern

9.0 DESCRIPTION OF ALTERNATIVES

9.1 Intermediate Groundwater Alternatives

An evaluation of remedial action alternatives for intermediate groundwater at the CPA Site was presented in the original FS (Fluor Daniel GTI, November 1997). The 1997 FS Report presented the following:

- Pertinent information from the RI and Baseline Risk Assessment;
- Discussion of applicable or relevant and appropriate requirements (ARARs);
- Remedial action objectives;
- General response actions and potential remedial technologies;
- Development and screening of remedial action alternatives; and
- Detailed analysis and comparative analysis of remedial action alternatives.

Five alternatives to address groundwater within the intermediate zone were developed in the 1997 FS Report. Based on the screening of alternatives, Alternative 2 (institutional controls) was not retained for further consideration as a stand-alone alternative. The September 1998 ROD for OU# 1 concurred with the elimination of institutional controls as a stand-alone alternative. Therefore, four alternatives were retained for consideration to address intermediate groundwater in the Focused FS (MTR, June 2001).

Additional characterization of the intermediate groundwater zone has been completed since preparation of the 1997 FS Report. Also, additional site-specific information and experience are now available based on implementation of the shallow groundwater zone remedial actions at the CPA Site. Therefore, refinement of the remedial action alternatives for intermediate groundwater was appropriate prior to the detailed evaluation and comparative analysis. The updated alternatives are described below.

9.1.1 Alternative 1 – No Action

No action provides a baseline for comparison with the other alternatives. No institutional controls or active remediation would be implemented under this alternative. However, long-term groundwater monitoring at sentinel wells on an annual basis would be conducted for a maximum period of 50 years.

Alternative 1 would not involve any capital costs, assuming the sentinel well system is in place as assumed for the other alternatives. Annual groundwater monitoring costs are estimated to be $22,000. Assuming an interest rate of 5 percent and a 50-year monitoring period, the estimated present worth cost is $402,000.

<u>Expected Outcome</u>

This alternative would not impact current land uses or expected redevelopment, other than the need to maintain the proposed sentinel well network. Groundwater quality would not be affected by this alternative other than through natural attenuation of contaminants. Monitoring for natural attenuation would not be conducted. Because exposure to intermediate groundwater does not currently exist and is not expected in the future, and monitoring of groundwater quality at the sentinel well locations would be conducted, this alternative may be adequately protective of human health.

9.1.2 Alternative 2 - Institutional Controls

Based on the screening of alternatives, Alternative 2 (institutional controls) was not retained for further consideration as a stand-alone alternative. The September 1998 ROD for OU# 1 concurred with the elimination of institutional controls as a stand- alone alternative.

9.1.3 Alternative 3 – Institutional Controls, DNAPL Removal and Monitored Natural Attenuation

Alternative 3 would include a deed restriction to prevent future use of intermediate groundwater on SCE&G property for drinking purposes. Removal of DNAPL from recovery wells would be conducted with stationary and portable pumping equipment, with a five-year duration assumed for cost estimating purposes. The recovered DNAPL would be staged temporarily on- site prior to transport for reuse or disposal, depending upon which method is the most cost effective at the time of removal. Monitoring of constituent concentrations and natural attenuation parameters on a semi- annual basis would be conducted using wells screened within the impacted area of the intermediate zone. Similar

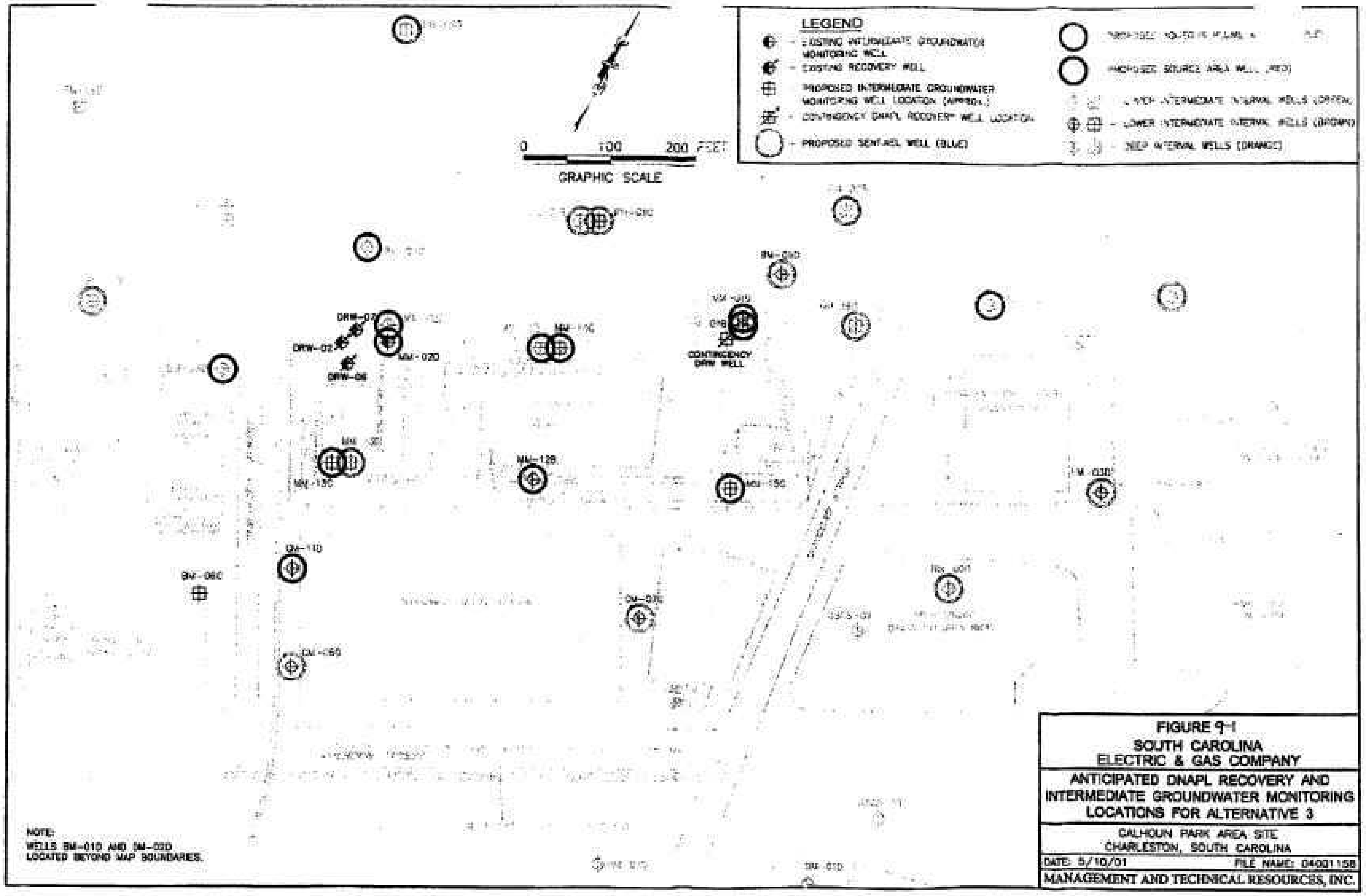


FIGURE 9-1
SOUTH CAROLINA ELECTRIC & GAS COMPANY

ANTICIPATED DNAPL RECOVERY AND INTERMEDIATE GROUNDWATER MONITORING LOCATIONS FOR ALTERNATIVE 3

CALHOUN PARK AREA SITE
CHARLESTON, SOUTH CAROLINA

DATE: 5/10/01 FILE NAME: 04001158

MANAGEMENT AND TECHNICAL RESOURCES, INC.

to Alternative 1, annual monitoring at sentinel well locations would also be performed. The groundwater monitoring component of this alternative is projected to occur for a 30-year period. The anticipated DNAPL recovery and groundwater monitoring locations are identified on Figure 9-1.

The capital cost to implement Alternative 3 is estimated to be $33,000, assuming that all monitoring wells are in place and one additional DNAPL recovery well would be required. Annual costs for DNAPL removal and groundwater monitoring are estimated to be $173,000. The annual groundwater monitoring cost following completion of DNAPL removal activities is estimated at $78,900. Assuming an interest rate of 5 percent, a 5-year DNAPL removal period and groundwater monitoring for a total period of 30 years, the estimated present worth cost is $1,654,000.

<u>Expected Outcome</u>
This alternative would not impact current land uses or expected redevelopment, other than the need to maintain the DNAPL recovery wells and monitoring well network. Groundwater quality would benefit from DNAPL removal, and the effects of natural attenuation of dissolved constituents would be monitored, although some of the constituents of concern (semi-volatiles) may not respond to natural attenuation or otherwise have very long response times.

9.1.4 Alternative 4 – Institutional Controls, DNAPL Removal and *In Situ* Treatment
Alternative 4 involves in situ treatment of impacted groundwater within the intermediate zone, in conjunction with the institutional controls, DNAPL removal and groundwater monitoring components of Alternative 3. The in situ treatment could involve injection of air or ORC to increase dissolved oxygen concentrations and stimulate microbial activity, which results in increased biodegradation of the dissolved constituents. In situ treatment using chemical oxidants (e.g., potassium permanganate, hydrogen peroxide or ozone) could also be conducted to directly destroy/degrade the constituents via chemical oxidation. Selection of the most appropriate oxidant for use at a specific site will be determined during remedial design. The selection of oxidant will be based on bench scale testing and field testing results. For cost estimating purposes, ORC injection via temporary borings was used to represent in situ treatment via oxidant addition. ORC injection is anticipated in two general areas: the former gas holder area in the western portion of the current electrical substation, and the northeast portion of the substation property. Six applications are assumed to be necessary, occurring on a semi-annual basis over a three-year period. The need for and timing of additional applications would be based on data obtained during active remediation. Based on the in situ treatment benefits of this alternative and the downgradient enhancement of natural attenuation, the total duration of groundwater monitoring is projected at 12 years. The conceptual layout of the injection points and the anticipated DNAPL recovery and groundwater monitoring locations are identified on Figure 9-2.

The capital cost of Alternative 4 is estimated at $33,000, assuming all monitoring wells are in place and one additional DNAPL recovery well is required. Annual costs for ORC injection, DNAPL removal and groundwater monitoring are estimated to be $235,600, reducing to $173,000 after ORC injection is completed, and reducing further to $78,900 after DNAPL removal is completed. Assuming an interest rate of 5 percent, a 5-year DNAPL removal period and groundwater monitoring for 12 years total, the estimated present worth cost is $1,319,000.

<u>Expected Outcome</u>
Under this alternative involving in situ treatment, current land uses and expected redevelopment would primarily be impacted only by maintenance of the DNAPL recovery and groundwater monitoring wells. Also, the periodic injection of ORC may involve a limited short-term effect upon the current and anticipated future land uses. Groundwater quality would benefit from DNAPL removal, and the natural attenuation of dissolved phase constituents would be supplemented by treatment via the oxidant addition.

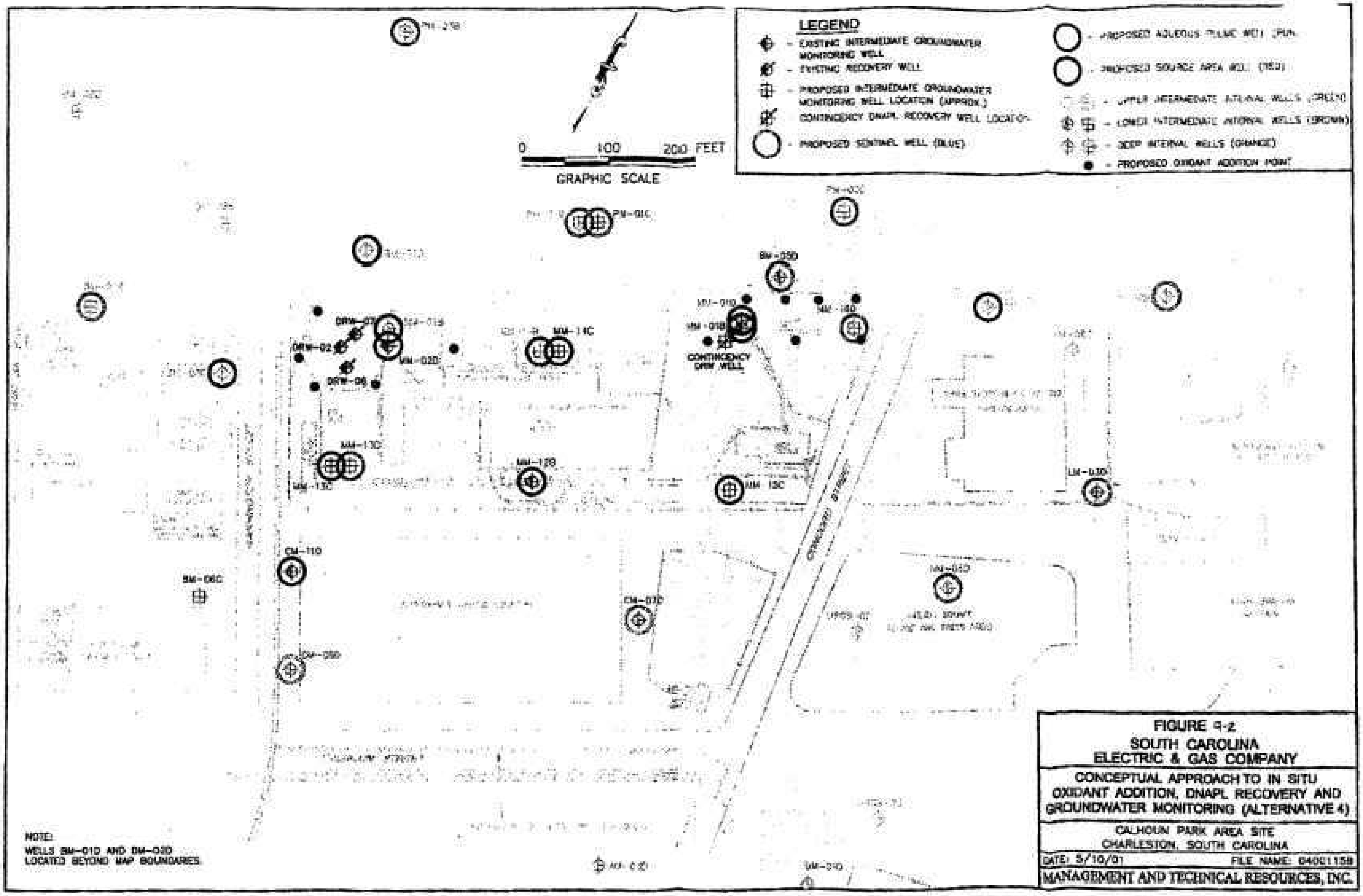


FIGURE 9-2
SOUTH CAROLINA
ELECTRIC & GAS COMPANY
CONCEPTUAL APPROACH TO IN SITU OXIDANT ADDITION, DNAPL RECOVERY AND GROUNDWATER MONITORING (ALTERNATIVE 4)
CALHOUN PARK AREA SITE
CHARLESTON, SOUTH CAROLINA
DATE: 5/10/01 FILE NAME: 04001159
MANAGEMENT AND TECHNICAL RESOURCES, INC.

9.1.5 Alternative 5 – Institutional Controls, DNAPL Removal, Extraction Wells, Separation and POTW Discharge

Alternative 5 involves extraction of impacted groundwater within the intermediate zone and discharge to the Public Owned Treatment Works (POTW), in addition to the institutional controls, DNAPL removal and monitoring components of Alternatives 3 and 4. Groundwater extraction would be intended to provide hydraulic containment and prevent potential migration of dissolved constituents, as well as to provide mass removal of dissolved phase constituents in the high concentration areas of the intermediate zone. The conceptual approach would involve installation of groundwater extraction wells in two general areas: the former gas holder area and the northeast portion of the substation property. Seven extraction wells are assumed for cost estimating purposes, with a combined groundwater extraction rate of 15 gpm. The recovered groundwater would be pumped to an equalization/ settling tank, with flow through a conventional oil/ water separator as a precaution prior to discharge to the POTW. Recovered DNAPL would be transported off-site for reuse or disposal. Permitting of the aboveground components of the groundwater management and disposal system would likely be required, and monitoring of the discharge would be performed routinely in accordance with POTW requirements. Based on the mass removal benefits of this alternative in addition to natural attenuation, and the need for adequate flow through the targeted treatment area to reach asymptotic groundwater concentrations, the total duration of this alternative is projected at 20 years. The conceptual layout of the groundwater extraction system and the anticipated DNAPL recovery and groundwater monitoring locations are identified on Figure 9-3.

The capital cost to implement Alternative 5 is estimated to be $336,000, assuming that all monitoring wells are in place and one additional DNAPL recovery well is installed. Annual costs for operation and maintenance of the groundwater extraction and discharge system, DNAPL removal and groundwater monitoring are estimated to be $211,000. Annual costs for monitoring and operation of the groundwater extraction system following the completion of DNAPL removal are estimated to be $116,900. Assuming an interest rate of 5 percent, a 5-year DNAPL removal period, and operation and maintenance of the groundwater extraction and discharge system and groundwater monitoring for a total period of 20 years, the estimated present worth cost is $2,201,000.

<u>Expected Outcome</u>

Current land uses and expected redevelopment would be impacted by the groundwater transfer conduits and aboveground units associated with management and disposal of the impacted groundwater. Well maintenance (including wells for DNAPL recovery, groundwater extraction and monitoring) would also require access through developed areas. Groundwater quality would benefit from DNAPL removal, and dissolved phase constituents would be addressed via mass removal and hydraulic control of migration.

9.2 Sediments

Because it was determined that additional characterization data were necessary, sediments were not included in the 1997 FS Report (Fluor Daniel GTI, November 1997). Remedial alternatives for sediments were identified and evaluated in the Focused Feasibility Study For Sediments (MTR, May 2002b), following completion of the additional characterization and assessment activities. The three alternatives included in the evaluation are described below.

9.2.1 Alternative 1 – No Action

No action provides a baseline for comparison with the other alternatives. No institutional controls or active remediation would be implemented. Limited monitoring of the existing sand blanket for stability would occur under this alternative. For cost estimating purposes, monitoring using vibracoring technology was assumed to be performed annually for a period of five years, which coincides with the Five-Year ROD review timeframe. This alternative may be adequately protective of human health, but may not be adequately protective of ecological receptors. This alternative may not meet the remedial action objectives of preventing exposure to benthic organisms or providing long- term stability

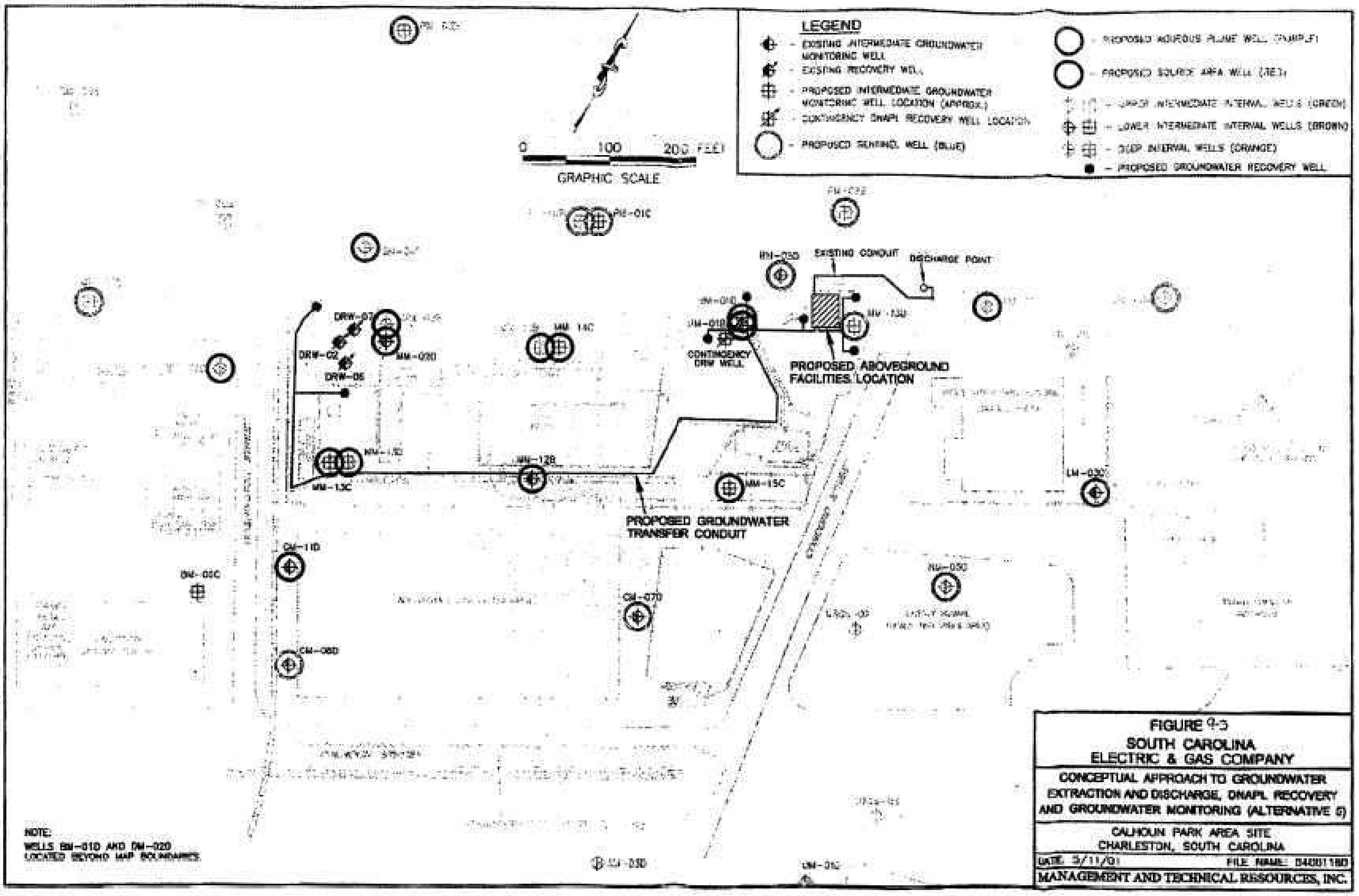


FIGURE 9-3
SOUTH CAROLINA ELECTRIC & GAS COMPANY
CONCEPTUAL APPROACH TO GROUNDWATER EXTRACTION AND DISCHARGE, DNAPL RECOVERY AND GROUNDWATER MONITORING (ALTERNATIVE 5)
CALHOUN PARK AREA SITE
CHARLESTON, SOUTH CAROLINA
DATE 5/11/01 FILE NAME: 04001160
MANAGEMENT AND TECHNICAL RESOURCES, INC.

of impacted sediment. Current land uses would not be affected. This alternative is readily implementable because no action is required other than limited monitoring. Assuming an interest rate of 5 percent, the estimated present worth cost of this alternative is $98,000.

9.2.2 Alternative 2 – Utilization of Existing Sand Blanket with Monitoring and Maintenance

EPA guidance documents cover the design, implementation and long- term monitoring of sub-aqueous in situ caps (e.g., sand blankets) intended to limit exposure to contaminated sediment (EPA, December 1998). As defined in the guidance, in- situ capping offers three primary functions:

- Physical isolation of the contaminated sediment;
- Stabilization of contaminated sediments, preventing re- suspension and transport; and
- Reduction of the flux of dissolved contaminants into the water column.

The shoreline from Charlotte Street southward to beyond the NPS tour boat facility has been redeveloped. A large portion of the area with ESGTU-HQs equal to or greater than one is covered by permanent structures or portions of the original sand blankets and as a result, current ecological exposure has been minimized. Alternative 2 would provide for performance monitoring of the existing sand blankets with contingency plans for maintenance as needed to maintain a minimum sand blanket thickness of one foot. Additional sampling would also be conducted at selected areas outside the sand blanket to document station-specific PAH and fractional organic carbon (Foc) concentrations in the vicinity of the aquarium and NPS dock.

For cost estimating purposes and based on the existing data, the impacted areas outside of the present sand blankets (with ESGTU HQs equal to or greater than one) may include an additional 20,000 square feet. Data from future sampling activities will be used to calculate ESGTU-HQs for the complete list of 34 PAHs specified in the draft ESGTU guidance. Analyzing for the complete list of 34 PAHs will reduce uncertainty, eliminate the need to apply the correction factor, and provide the most accurate definition of sediments of concern. Results of the additional sampling will determine the actual extent of sand blanket expansion, if required. The cost contingency for sand blanket expansion is approximately $77,000 and includes placing a one-foot thick sand blanket over the additional 20,000 square feet, if required.

For cost estimating purposes, sand blanket monitoring using vibracoring technology was assumed to be performed semi-annually for a period of two years, and thereafter annually for a period of three years (five years of monitoring total). This schedule coincides with the five-year ROD review timeframe where the protectiveness of the remedy will be reviewed. Monitoring would occur at several locations as proposed in Figure 9-4. During the monitoring, maintenance and augmentation would occur as needed to ensure the on-going effectiveness of the sand blanket. If results of monitoring suggest that the existing sand blanket is unstable and not effective as a long- term remedy, then replacement or stabilization activities could be undertaken with additional monitoring to document effectiveness and stability. For cost estimating purposes, it was assumed that replacement of 50 percent of the sand blanket cover would be required once, at the end of the five-year monitoring period.

If the results of the monitoring suggest that the existing sand blanket is unstable and not effective as a long-term remedy, then replacement or stabilization activities would be undertaken with additional monitoring to document effectiveness and stability. In the event that sand blanket erosion is determined to be an ongoing problem that requires repeated replenishment, placement of more course grain material (gravel) atop the existing sand cover would be performed to mitigate the potential for erosion. If gravel were to be placed across 50 percent of the area where ESGTU-HQs greater than one occur, excluding

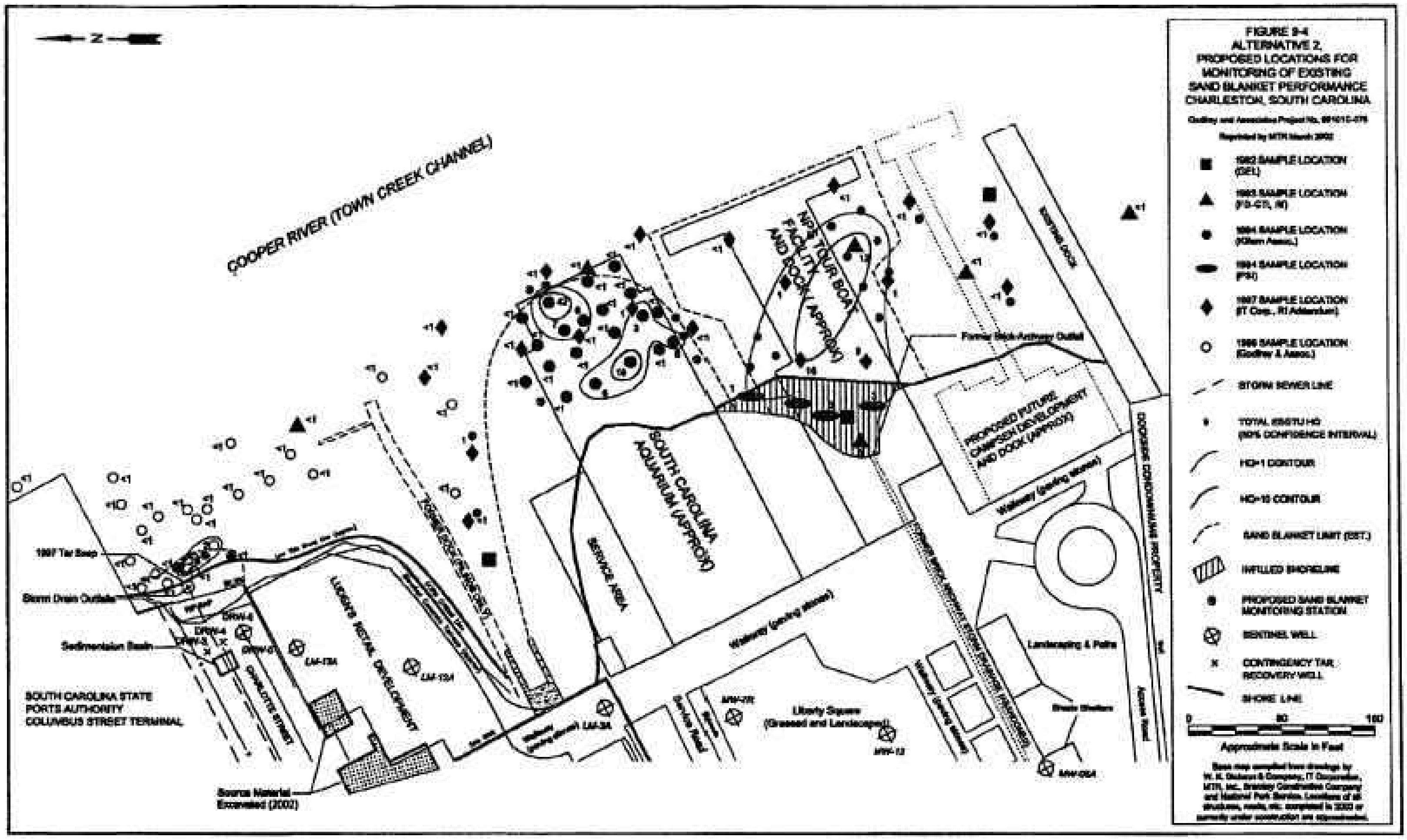


FIGURE 9-4
ALTERNATIVE 2,
PROPOSED LOCATIONS FOR
MONITORING OF EXISTING
SAND BLANKET PERFORMANCE
CHARLESTON, SOUTH CAROLINA
1993 SAMPLE LOCATION
1997 SAMPLE LOCATION
STORM SEWER LINE
SAND BLANKET LIMIT (EST.)
INFILLED SHORELINE
PROPOSED SAND BLANKET MONITORING STATION
SENTINEL WELL
CONTINGENCY TAR RECOVERY WELL
SHORE LINE
0
80
160
Approximate Scale in Feet
COOPER RIVER (TOWN CREEK CHANNEL)
SOUTH CAROLINA AQUARIUM (APPROX)
SERVICE AREA
PROPOSED FUTURE CAMPSEN DEVELOPMENT AND DOCK (APPROX)
1997 Tar Seep
Storm Drain Outfalls
Sedimentation Basin
SOUTH CAROLINA STATE
PORTS AUTHORITY
COLUMBUS STREET TERMINAL
Source Material
Excavated (2002)
Liberty Square
(Grassed and Landscaped)
Landscaping & Paths
Walkway (paving stones)
Former Slope-Anthony Outfall

those areas beneath the aquarium and NPS structures, the estimated cost would be approximately $115,000.

Expected Outcome

Implementation of this alternative would ensure the continued isolation (reduced exposure potential and mobility) of the impacted sediments, but would not reduce the toxicity and volume other than through natural attenuation processes. This alternative would not impact current land uses. This alternative is readily implementable. The estimated annual O&M costs range from $33,400 to $258,000 (with sand augmentation and supplemental gravel cover) over the projected five-year monitoring period. Assuming an interest rate of 5 percent, the total estimated present worth cost of this alternative is $292,000 with no contingencies and $545,000 with all contingencies included.

9.2.3 Alternative 3 – Excavation, Off-Site Thermal Desorption and Backfill with Monitoring

This alternative involves the excavation, where accessible, of impacted sediments and treatment of the material at an off-site low temperature thermal desorption (LTTD) unit. The thermal desorption process requires heating the sediments to elevate the vapor pressure of the constituents enabling diffusion through and volatilization from the sediments. Clean sand would be used to backfill the excavated areas.

Given the development that has recently occurred, most locations are covered by man- made structures and cannot be effectively excavated. There are, however, areas where sediment characterized by ESGTU-HQs equal to or greater than one may be accessible (Figure 1-4). For cost estimating purposes, a total impacted area of 2350 cubic yards was assumed for removal. This includes areas outside the footprint of the aquarium and NPS dock, as well as the area with ESGTU-HQs equal to or exceeding one at the former Charlotte Street seep (Figure 1-4). The excavation would involve removal of the existing sand blanket (estimated at one to three feet in thickness) and the underlying sediment to an assumed total depth of five feet (total removal volume of 2350 cubic yards). Additionally, other areas would be excavated based on ESGTU-HQs equal to or greater than one where the sand blanket is not present. For cost estimating purposes, this area is approximately 20,000 square feet and a 2-foot depth of excavation was assumed (1,500 cubic yards). Because sediments underneath the existing buildings would remain in place (approximately 50 percent of the area is covered by permanent structures), this alternative also includes a monitoring component. Monitoring of sand blanket performance along the perimeter of the building footprints would occur as described in Alternative 2.

This alternative would minimize future aquatic ecological risks by removing the impacted sediments that exist outside the building footprints. This is a permanent remedy that uses treatment as a principal element. This alternative would result in a reduction in toxicity, mobility and volume of impacted sediment. The LTTD technology proposed for this alternative has been demonstrated effective and is commercially available in reasonable proximity to the site. However, there are significant limitations to implementing this alternative based on the limited access to impacted areas. Potential disruptions to the tourist facilities while completing the excavation activities are anticipated to be minimal in duration, but also must be considered. In addition, the excavation of impacted sediment would necessitate implementing engineering controls and performance monitoring during the excavation process. Such monitoring would allow termination of removal activities if acute toxicity conditions occur. In addition, the excavation could result in suspension and redeposition of impacted sediment, and an attendant potential for ecological exposure in adjacent areas.

The estimated capital cost of this alternative is $1,401,000. The estimated annual O&M costs range from $19,900 to $39,800 over the projected five- year monitoring period. Assuming an interest rate of 5 percent, the total estimated present worth cost of this alternative is $1,531,000.

10.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

10.1 Intermediate Groundwater Alternatives

Four remedial action alternatives for intermediate groundwater were retained for the detailed evaluation. The alternatives include the following:

- Alternative 1 – No Action;
- Alternative 3 – Institutional Controls, DNAPL Removal and Monitored Natural Attenuation;
- Alternative 4 – Institutional Controls, DNAPL Removal and In Situ Treatment; and
- Alternative 5 – Institutional Controls, DNAPL Removal, Extraction Wells, Separation and POTW Discharge.

Each alternative was evaluated using seven evaluation criteria. A summary of the evaluation for each alternative is presented in Table 10-1. This section presents a comparative analysis of the alternatives using the same seven criteria.

10.1.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/ or institutional controls.

The no action alternative may not be adequately protective. The lack of institutional controls, DNAPL recovery, or active treatment of dissolved phase constituents makes the no action alternative least effective overall in protecting human health and the environment. Alternatives 3, 4 and 5 are effective in regards to this criterion, with Alternatives 4 and 5 slightly better due to actively addressing the dissolved phase constituents. Alternative 4 offers the most protection of human health and the environment, as it actively destroys constituents in situ with no waste products generated.

10.1.2 Compliance With ARARs

Section 121(d) of CERCLA and NCP Section 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs", unless such ARARs are waived under CERCLA Section 121(d)(4).

Applicable requirements are those clean-up standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous constituent, remedial action, location or other circumstance found at a CERCLA site. Relevant and appropriate requirements, while not "applicable” address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those State standards that are identified by a State in a timely manner and that are more stringent than Federal requirements may be applicable or relevant and appropriate. Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes or provides a basis for invoking a waiver.

The actions under each alternative appear to be implementable in compliance with ARARs. No action (Alternative 1) is not likely to achieve anticipated clean- up goals, because neither DNAPL removal nor removal/destruction of dissolved phase constituents is a component of the alternative. Alternative 4 offers the most potential for improvement in groundwater, quality conditions because of the in situ active destruction of constituents in groundwater. Alternative 5 also offers improvement in groundwater quality by removal of

TABLE 10-1

SUMMARY OF INTERMEDIATE GROUNDWATER
ALTERNATIVES EVALUATION

SCE&G Calhoun Park Area Site
Charleston, South Carolina

Criteria	Alternative 1 No Action (with Monitoring)	Alternative 3 Institutional Controls, DNAPL Removal and Monitored Natural Attenuation	Alternative 4 Institutional Controls, DNAPL Removal and *In Situ* Treatment	Alternative 5 Institutional Controls, DNAPL Removal, Extraction Wells, Separation and POTW Discharge
Overall Protection of Human Health and the Environment	■ May provide adequate protection ■ Free phase DNAPL a threat of increased environmental impacts	■ May provide adequate protection ■ Source removal mitigates potential for increased environmental impacts	■ May provide adequate protection ■ Source removal combined with *in situ* treatment mitigates potential for increased environmental impacts	■ May provide adequate protection ■ Source removal combined with groundwater extraction mitigates potential for increased environmental impacts
Compliance with ARARs	■ Activities should comply ■ Impacted area would not comply with groundwater standards	■ Activities should comply ■ Groundwater standards would likely not be met within impacted area	■ Activities should comply ■ Involves active treatment to reduce constituent levels, although standards may not be met within impacted area due to residual DNAPL	■ Activities should comply, although requirements associated with the groundwater discharge may provide constraints ■ Involves groundwater extraction to reduce constituent levels although standards may not be met within impacted area due to residual DNAPL
Short-Term Effectiveness	■ Effective in protecting community and remediation workers ■ Environmental effects downgradient of sentinel wells not expected ■ Minimal effectiveness within impacted area	■ Effective in protecting community and remediation workers ■ Environmental effects downgradient of sentinel wells not expected ■ Fair to moderately effective within impacted area	■ Effective in protecting community and remediation workers ■ Environmental effects downgradient of sentinel wells not expected ■ Effectiveness considered good within impacted area	■ Should be protective of community and remediation workers, although aboveground management of impacted groundwater increases exposure potential ■ Environmental effects downgradient of sentinel wells not expected ■ Effectiveness considered moderate within impacted area ■ Potential off-site benzene source may adversely impact effectiveness in gas holder area
Long-Term Effectiveness and Permanence	■ May provide adequate long-term protection ■ Residual risks related to continuing presence of free phase DNAPL	■ Adequate long-term protection ■ Source removal reduce & residual risks, with monitoring as control	■ Adequate long-term protection ■ Source removal and *in situ* treatment reduce residual risk, with monitoring as control	■ Adequate long-term protection ■ Source removal and groundwater extraction reduce residual risk with monitoring as control
Reduction of Toxicity, Mobility or Volume through Treatment	■ No direct treatment ■ Reductions only through natural attenuation, which would not be monitored ■ Free phase DNAPL would remain as source to groundwater	■ DNAPL removal would provide benefits ■ No direct treatment ■ Reductions only through natural attenuation would be monitored	■ DNAPL removal would provide benefits ■ Direct treatment of impacted groundwater provided	■ DNAPL removal would provide benefits ■ Removal of dissolved phase constituents would occur via groundwater extraction ■ Extraction in gas holder area may increase mobility of potential off-site benzene source
Implementability	■ No site impacts other than maintaining wells ■ Readily implementable	■ No site impacts other than maintaining wells ■ Readily implementable	■ Site impacts limited to maintaining wells and periodic ORC injection ■ Administrative requirements should be achievable ■ Considered implementable	■ Site impacted by groundwater transfer conduits and aboveground units, as well as need to maintain wells ■ Administrative requirements would include permitting for groundwater discharge ■ Considered implementable, with some technical and administrative constraints
Cost	■ Capital costs $0 ■ Annual costs $22,000 ■ Estimated present worth cost $ 402,000	■ Capital costs $ 33,000 ■ Annual costs $173,000 (years 1 through 5) $78,900 (years 6 through 30) ■ Estimated present worth cost $ 1,654,000	■ Capital costs $ 33,000 ■ Annual costs $235,600 (years 1 through 3) $173,000 (years 4 and 5) $78,900 (years 6 through 12) ■ Estimated present worth cost $ 1,319,000	■ Capital cost $ 336,000 ■ Annual costs $211,000 (years 1 through 5) $116,900 (years through 20) ■ Estimated present worth cost $ 2,201,000

dissolved constituents, but in a slow and gradual manner requiring a longer period of time for restoration. Table 10-1 contains a summary of each alternatives ability to meet ARARs.

10.1.3 Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until the remedial action objectives are achieved.

None of the alternatives appear to have the potential for significant adverse short-term effects on the community or remediation workers. Where potential exposure may occur, routine procedures are available to mitigate the potential risks and assure adequate protection. The short-term effectiveness of any alternative in addressing dissolved phase constituents within the impacted area depends upon the residual DNAPL amount. Alternative 4 (which includes in situ treatment) appears to be the most effective alternative in addressing the impacted intermediate groundwater zone in the lease amount of time, with Alternative 5 considered moderate, Alternative 3 fair to moderate, and Alternative 1 (no action) minimal in terms of short-term effectiveness.

10.1.4 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once the remedial action objectives have been met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

The no action alternative would not be adequately protective regarding this criterion. The lack of institutional controls, DNAPL recovery, or active treatment of dissolved phase constituents makes the no action alternative less effective overall regarding long-term effectiveness and permanence.

Alternatives 3, 4 and 5 are similar to one another, although Alternatives 4 and 5 are considered slightly more effective because dissolved phase constituents are actively addressed.

Reviews at least every five years, as required, would be necessary to evaluate the effectiveness of any of the alternatives because contaminants will likely remain on- site above clean-up goals due to the presence of residual DNAPL.

10.1.5 Reduction of Toxicity, Mobility or Volume Through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy. Alternative 1 (no action) would be ineffective regarding this criterion, and the lack of DNAPL removal makes this alternative unacceptable. DNAPL removal and groundwater constituent reductions in volume in varying amounts would occur with Alternatives 3, 4 and 5. Alternative 3 would not likely have any significant effect upon the dissolved phase plume, however Alternative 4 provides for additional reductions through in situ treatment. Alternative 5 also provides for mass removal through extraction of impacted groundwater.

10.1.6 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other government entities are also considered.

Because Alternative 1 only involves sentinel well monitoring, it would be the easiest to implement both technically and administratively. However, the institutional control, DNAPL removal, and additional groundwater monitoring components included with Alternatives 3, 4 and 5 are considered readily implementable. Therefore, the primary considerations in comparing the implementability of these alternatives involve the oxygen addition component of Alternative 4 and the groundwater extraction and POTW discharge component of Alternative 5. Based on the information presented above, both alternatives are considered implementable at this time. However, Alternative 4 would be considered as the more readily implementable of these two alternatives.

10.1.7 Cost

Assuming a 50-year monitoring period due to the continued presence of free phase DNAPL, the estimated present worth cost for Alternative 1 is $402,000. Based on six semi-annual applications of ORC, a 5-year DNAPL removal period and groundwater monitoring for 12 years total, the estimated present worth cost for Alternative 4 is $1,319,000. Assuming a 5-year DNAPL removal period and groundwater monitoring for a total period of 30 years, the estimated present worth cost for Alternative 3 is $1,654,000. Assuming a 5-year DNAPL removal period, with operation and maintenance of the groundwater extraction and discharge system and groundwater monitoring for a total period of 20 years, the estimated present worth cost for Alternative 5 is $2,201,000.

With the lowest estimated capital and annual costs, Alternative 1 also has the lowest estimated present worth cost even though a 50-year monitoring period was projected. Alternatives 3 and 4 have similar capital and annual costs, with the difference being annual ORC injection costs for Alternative 4 and a corresponding reduction in the monitoring time frame. Based on the estimates summarized above, in situ treatment would have a lower present worth cost than only monitoring natural attenuation for a longer period of time. Alternative 5 has the highest capital cost estimate, highest annual costs, and the highest estimated present worth cost.

10.1.8 State Acceptance

The South Carolina Department of Health & Environmental Control (SC DHEC) has expressed its support for the selection of groundwater alternative 4 (institutional controls, DNAPL removal, and in-situ treatment) to address intermediate groundwater at this site. The SC DHEC believes that groundwater alternative 4 will be of benefit in the reduction of risk at the site achieving long term protection of human health and the environment. The SC DHEC concurrence letter is attached to this ROD as Appendix A.

10.1.9 Community Acceptance

A public meeting was held on July 8, 2002, to discuss the remedial alternatives under consideration and EPA's Proposed Plan for cleanup of the Calhoun Park Superfund Site. A 30-day public comment period on EPA's Proposed Plan was held from July 8, 2002 to August. 8, 2002. A copy of all comments received, EPA's response to these comments, and a verbatim transcript of the public meeting are attached to this ROD as Appendix B. In general the community expressed acceptance with EPA's selection of alternative 4 (institutional controls, DNAPL removal, and in-situ treatment) to address intermediate groundwater at this site.

10.1.10 Comparison Summary

Alternative 1 (no remedial action, with sentinel well monitoring) is the least effective alternative for addressing intermediate zone groundwater. However, it serves as a baseline for comparison with the other alternatives. Primarily because DNAPL removal is not a component of Alternative 1, the overall effectiveness in achieving the remedial action objectives is unacceptable. The DNAPL removal, institutional controls and additional groundwater monitoring associated with the other alternatives provide more effectiveness in meeting the objectives, as well as providing additional measures to assure protection of human health and the environment.

The primary difference between Alternatives 3, 4 and 5 involves how dissolved phase constituents are addressed within the impacted portion of the intermediate zone, in conjunction with DNAPL removal. Alternative 3 relies solely upon natural attenuation which may not have any significant effect for a long time period, while Alternative 4 provides aggressive in situ treatment, and Alternative 5 provides gradual removal via groundwater extraction.

In situ treatment (Alternative 4) is clearly more effective than relying on natural attenuation alone (Alternative 3), and reductions in groundwater monitoring requirements would offset the costs of in situ treatment on a present worth basis. With Alternative 4, oxygen addition would allow biodegradation to reduce constituent concentrations at an accelerated rate. Increased biodegradation of constituents adsorbed to aquifer materials will also occur. With Alternative 5, dissolved phase constituents would be removed via groundwater extraction. However, biodegradation would not improve to the extent produced by Alternative 4, and system operation and groundwater monitoring are expected to require a longer period.

Table 10-2 presents a graphical summary of the overall acceptability of each intermediate groundwater remedial action alternative regarding the evaluation criteria. Alternative 1 (no action, with monitoring) yields the least acceptable results in terms of the evaluation criteria. Alternatives 3, 4 and 5 differ only in how the dissolved phase constituents are addressed within the intermediate zone (institutional controls and source removal are components of each alternative). Alternative 3, (institutional controls, source removal and monitored natural attenuation) provides only fair reduction of toxicity, mobility or volume of the COCs and does not include active treatment. Alternatives 4 and 5 provide the most acceptable results in terms of long-term effectiveness and reduction of toxicity, mobility or volume through treatment.

10.2 Sediments

Three remedial action alternatives for sediments were retained for the detailed evaluation. The alternatives include the following:

- Alternative 1 – No Action;
- Alternative 2 – Utilization of Existing Sand Blanket with Monitoring and Maintenance; and
- Alternative 3 – Excavation, Off-Site Thermal Desorption and Backfill with Monitoring.

Each alternative was evaluated using the seven evaluation criteria also utilized for intermediate groundwater, and the general description of each criterion for sediments is essentially the same as that provided with the intermediate groundwater comparative analysis. A summary of the evaluation for each alternative is presented in Table 10-3. This section presents a comparative analysis of the alternatives using the same seven criteria.

10.2.1 Overall Protection of Human Health and the Environment

The potential for erosion of the existing sand blanket and exposure of impacted sediments to benthic organisms makes no action alternative the least effective alternative overall in protecting human health and the environment. Alternatives 2 and 3 are similar to each other regarding this criterion. Alternative 3 may offer some additional protection of ecological receptors through removal of accessible impacted sediments. However, there is a potential for increased exposure to constituents from suspension and redeposition of sediments during excavation.

TABLE 3

SUMMARY OF ALTERNATIVES EVALUATION FOR SEDIMENTS

SCE&G Calhoun Park Area Site
Charleston, South Carolina

Criteria	Alternative 1 No Action	Alternative 2 Utilize Existing Sand Blanket (with Routine Monitoring)	Alternative 3 Removal, Off-Site Thermal Desorption and Backfill (with Building Perimeter Monitoring)
Overall Protection of Human Health and the Environment	• May provide adequate protection of human health, but may not provide adequate protection to ecological receptors based on the Ecological Risk Assessment. • There is potential for erosion of the existing sand blanket which could increase exposure of sediments to ecological receptors.	• May provide adequate protection of human health and to ecological receptors through monitoring and maintaining the existing sand blanket thickness.	• Would provide adequate protection of human health and the ecological receptors by removing the impacted sediments, offsite treatment and backfilling with clean sand. This would essentially remove the exposure source except under buildings where removal of sediments is not feasible. The existing sand blanket under the buildings would be monitored along the immediate perimeter of the building footprint for stability. • Contaminated sediment could be suspended and redeposited in adjacent areas during excavation.
Compliance with Sediment ARARs	• Is expected to be in compliance with ARARs for implementation. However, no action may not satisfy the objectives of the remedial action.	• Chemical-specific TBCs and location-specific ARARs can be achieved by monitoring and maintaining the sand blanket. • Compliance with action-specific ARARs can be achieved by meeting the substantive requirements associated with dredging and filling regulations. This would be applicable during future amendments to the existing sand blanket, if required.	• Can comply with all chemical-specific TBCs and location-specific ARARs by removing the sediments, off-site treatment of sediments and backfilling with clean sand. • Action-specific ARARs can be achieved by complying with the substantive requirements associated with dredging and filling; erosion and sediment control and off-site transportation regulations.
Short-Term Effectiveness	• Effective in protecting community and remediation workers • Minimal effectiveness within impacted area	• Effective in protecting community, remediation workers and benthic communities. Limited minimal exposure for remediation workers. • Engineering controls required for applying additional sand blanket, if required. • Fair to moderately effective within impacted area	• Effective in protecting community, remediation workers and benthic communities. During removal of sediments, remedial workers may potentially be minimally exposed to constituents in sediment through dermal contact, inhalation and/or ingestion. Ecological receptors may be exposed to suspended sediment during excavation. • Engineering controls would be required during implementation to protect impacts to workers and benthic communities. • Effectiveness considered good within accessible impact areas
Long-Term Effectiveness and Permanence	• Ulikely to provide adequate long-term protection • Residual risks related to continuing presence of impacted sediments	• Adequate long-term protection • Routine monitoring for integrity of the sand blanket is required • May need to augment sand blanket in the future due to erosion	• Adequate long-term protection • Permanent remedy for accessible areas
Reduction of Toxicity, Mobility or Volume through Treatment	• No direct treatment • Reductions only through natural attenuation, which would not be monitored • Potential aquatic exposure remains a concern	• Does not involve the removal of the impacted sediments. • No direct treatment to reduce toxicity or volume • Mobility will be significantly reduced by monitoring the existing sand blanket. Maintenance is required to assure reduction of mobility. • Reduction through natural attenuation, which would not be monitored	• Constituents removed from accessible areas • Most reduction in toxicity, mobility and volume. Suspension and redeposition of contaminated sediment are a concern for this alternative. • Treatment via thermal desorption is proven effective
Implementability	• No adverse site impacts from implementability • Readily implementable	• Readily implementable • Construction techniques require engineering controls (e.g., silt curtain) • Need to establish a long-term cover/cap monitoring system	• Limited access to affected areas severely restricts the implementability of this alternative • Considered readily implementable in certain areas • Administrative requirements should be achievable-OCRM permits
Cost	• Capital costs $0 • Annual costs $0 • Estimated present worth cost $0	• Operation and Maintence costs $ 100,600 (Assumes 50% replacement of existing sand blanket at the end of 5 year monitoring period) • Annual monitoring costs $66,800 (year 1 and 2) • Annual monitoring costs $33,400 (year 3 - year 5) • Estimated present worth cost $296,000	• Capital costs $558,000 (reflective of areas that are accessible for removal) • Annual monitoring cost $39,800 (year 1 and 2) • Annual monitoring costs $19,900 (year 3 - year 5) • Estimated present worth cost $688,000

10.2.2 Compliance With ARARs

The actions under each alternative appear to be implementable in compliance with ARARs. Due to the presence of existing structures, impacted sediments will remain with each alternative. No action (Alternative 1) is the least likely alternative to achieve the ARARs. Alternatives 2 and 3 are similar in their ability to achieve compliance with ARARs.

10.2.3 Short-Term Effectiveness

None of the alternatives appear to have the potential for significant adverse short- term effects on the community or remediation workers. Alternative 3 has the most potential for adverse short-term effects due to the excavation activities and associated potential for exposure to impacted material. For activities where exposure may occur, routine procedures are available to mitigate the potential risks and assure adequate protection. The short-term effectiveness regarding environmental impacts may be adequate with Alternative 1 (no action). However, Alternative 2 may be more reliable because the sand blankets would be readily implementable. A consideration in evaluating the short-term effectiveness of Alternative 3 involves the potential suspension and redeposition of sediments during excavation, which may cause adverse environmental impacts.

10.2.4 Long-Term Effectiveness and Permanence

The no action alternative may not be adequately protective regarding this criterion, due to the lack of comprehensive sand blanket monitoring and the potential for unchecked erosion. Alternatives 2 and 3 have similar long- term effectiveness. Alternative 3 provides a more permanent remedy because impacted sediments are removed where accessible, rather than augmenting the sand blanket if needed in the future (Alternative 2).

10.2.5 Reduction of Toxicity, Mobility or Volume Through Treatment

Alternatives 1 and 2 do not involve direct treatment of impacted sediments. Constituent reductions would occur only through natural attenuation, which would not be monitored. Alternative 2 would more reliably address potential migration through augmentation, if needed, of the sand blankets but would not reduce the volume or toxicity of constituents. Alternative 3 would provide effective treatment of impacted sediments via LTTD after excavation. Alternative 3 provides a volume reduction through excavation and treatment.

10.2.6 Implementability

The sand blanket monitoring proposed under each alternative is considered readily implementable. Because Alternative 1 involves no remedial action, it would be the easiest alternative to implement both technically and administratively. Augmenting of the existing sand blanket is implementable in accessible areas, as is removal of impacted sediments and placement of clean backfill. Both Alternatives 2 and 3 are considered implementable at this time, although Alternative 3 will involve additional administrative requirements and the overall implementability is severely limited by access constraints.

10.2.7 Cost

Based on annual sand blanket monitoring for five years, the estimated present worth cost for Alternative 1 is $98,000. Based on semi-annual monitoring of the sand blanket (including at the building perimeters) for two years and annual monitoring for three additional years (five years total), with 50 percent replacement of the sand blanket after five years, the estimated present worth cost for Alternative 2 is $292,000. Augmentation of the blanket using gravel, if necessary, would result a total present worth cost of $545,000. Based on an excavation volume of approximately 2350 cubic yards in accessible areas, and monitoring of the sand blanket at the building perimeters at frequencies similar to Alternative 2, the estimated present worth cost for Alternative 3 is $1,531,000.

Because Alternative 1 (no action) involves only limited monitoring, it is the lowest cost alternative. Monitoring costs associated with Alternative 2 are higher than for Alternative 3 due to the additional sand blanket monitoring points in areas where sediments would be excavated in Alternative 3. However, based on the estimates summarized above, Alternative 3 has the highest initial capital costs and the highest estimated present worth cost.

10.2.8 State Acceptance

The South Carolina Department of Health & Environmental Control (SC DHEC) has expressed its support for the selection of sediment alternative 2 (utilization of existing sand blanket with monitoring and maintenance) to address sediments of concern for this site. The SC DHEC. believes that this alternative will be of benefit in the reduction of risk at the site achieving long term protection of human health and the environment. The SC DHEC concurrence letter is attached to this ROD as Appendix A.

10.2.9 Community Acceptance

A public meeting was held on July 8, 2002, to discuss the remedial alternatives under consideration and EPA's Proposed Plan for cleanup of the Calhoun Park Superfund Site. A 30-day public comment period on EPA's Proposed Plan was held from July 8, 2002 to August 8, 2002. A copy of all comments received, EPA's response to these comments, and a verbatim transcript of the public meeting are attached to this ROD as Appendix B. In general the community expressed acceptance with EPA's selection of alternative 2 (utilization of existing sand blanket with monitoring and maintenance) to address sediments of concern at this site.

10.2.10 Comparison Summary

Alternative 1 (no action) is the least effective alternative for addressing impacted sediments. However, it serves as a baseline for comparison with the other alternatives. It is the lowest cost and most easily implementable of the three alternatives. Because the integrity of the existing sand blanket is not known and monitoring for protection of benthic organisms from exposure to impacted sediments would be limited, the overall effectiveness of Alternative 1 in achieving the remedial action objectives is unacceptable. The sand blanket monitoring associated with the other two alternatives provides more effectiveness in meeting the objectives, as well as providing additional measures to assure compliance with ARARs and protection of human health and the environment.

Table 10-4 presents a graphical summary of the overall acceptability of each sediment remedial action alternative regarding the evaluation criteria. Alternative 1 (no action) yields the least acceptable results in terms of the evaluation criteria. Alternative 2 (utilization of existing sand blankets, with monitoring) and Alternative 3 (excavation, LTTD treatment and backfill, with monitoring) differ primarily regarding short-term effectiveness and implementability, and the costs associated with excavation of the accessible sediments of concern. Alternatives 2 and 3 are similarly effective regarding this criterion. Alternative 3 may offer some additional protection of ecological receptors through removal of accessible impacted sediments. However, there is a potential for increased exposure to constituents from suspension and redeposition of sediments during excavation. Alternatives 2 and 3 provide the most acceptable results in terms of long-term effectiveness and reduction of toxicity, mobility or volume through treatment. Alternative 2, utilization of existing sand blankets (with monitoring), is best capable of achieving the objectives and has been identified as the most practicable remedy.

11.0 PRINCIPAL THREAT WASTE

The NCP establishes an expectation that treatment will be used to address principal threats posed by a site wherever practicable. Identifying principal threat wastes combines concepts of both hazard and risk. The principal threat concept is applied to the characterization of source materials, which contain hazardous constituents that act as a reservoir for migration or as a source for direct exposure. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would pose a significant risk to human health or the environment should exposure occur. Conversely, non-principal threat wastes, or low-level threat wastes, are source materials that generally can be reliably contained and would pose only a low risk in the event of exposure (EPA, July 1999).

Source material that would generally be considered to constitute a principal threat within OU#2 at the CPA Site includes DNAPL within the intermediate groundwater zone. However, EPA guidance (EPA, August 1997) states that program experience has shown that removal or in situ treatment of DNAPL may not be practicable. Hence, EPA generally expects that the quantity of free-phase DNAPL should be reduced to the extent practicable and that a containment strategy be developed. Migration of DNAPL within the intermediate zone does not appear to be occurring at the CPA Site based on the site characterization data. Therefore, the principal threat (DNAPL) is most appropriately addressed via removal to the extent practicable.

PAHs have been identified as constituents of concern in impacted sediments, due to potential exposure to benthic organisms should sand blanket erosion occur. Based on the sediments impacted by PAHs and the potential ecological risks calculated in the ERA, impacted sediments are considered a low-level threat source material at the CPA Site.

12.0 SELECTED REMEDY

This section provides a description of the components of EPA's Selected Remedy for Operable Unit 2 at the CPA Site in Charleston, South Carolina. The remedy has been selected under the authority granted in CERCLA and is consistent with the requirements of the NCP. The Selected Remedy is based upon a full consideration of remedial alternatives.

12.1 Rationale for the Selected Remedy

Intermediate Groundwater

Sufficient information exists for EPA to select a remedy capable of achieving the remedial action objectives for intermediate groundwater at the CPA Site. The remedial goals are summarized in Table 8-1. Due to the presence of residual DNAPL that will remain within the intermediate zone, alternative 4 is the alternative most likely to meet the remedial goals throughout the impacted portion of the intermediate zone.

Table 10-2 presents a graphical summary of the overall acceptability of each intermediate groundwater remedial action alternative regarding the evaluation criteria. Alternative 1 (no action, with monitoring) yields the least acceptable results in terms of the evaluation criteria. Alternatives 3, 4 and 5 differ only in how the dissolved phase constituents are addressed within the intermediate zone (institutional controls and DNAPL removal are components of each alternative). Alternative 3, (institutional controls, DNAPL removal and monitored natural attenuation) provides only fair to moderate reduction of toxicity, mobility or volume of the constituents of interest and does not include active treatment.

Alternatives 4 and 5 provide the most acceptable results in terms of long- term effectiveness and reduction of toxicity, mobility or volume through treatment. Based on the detailed evaluation, Alternative 4 (institutional controls, DNAPL removal and in situ treatment) is the best overall remedial action to address impacts within the intermediate zone at the CPA Site. It should be noted that Alternative 5 (institutional controls, DNAPL removal, extraction wells, separation and POTW discharge) is also capable of attaining site- wide objectives, but difficulties associated with implementability, and the higher capital and operation and maintenance costs, render it less acceptable than Alternative 4.

Sediments

Table 10-2

SUMMARY OF COMPARATIVE ANALYSIS
FOR INTERMEDIATE GROUNDWATER ALTERNATIVES

SCE&G Calhoun Park Area Site
Charleston, South Carolina

Criteria	**Alternative 1** **No Action (with Monitoring)**	**Alternative 3** **Institutional Controls, DNAPL Removal and Monitored Natural Attenuation**	**Alternative 4** **Institutional Controls, DNAPL Removal and *In Situ* Treatment**	**Alternative 5** **Institutional Controls, DNAPL Removal, Extraction Wells, Separation and POTW Discharge**
Overall Protection of Human Health and the Environment	Least protective	Slightly less protective than 4 or 5 (dissolved not actively addressed)	Similar to Alternative 5	Similar to Alternative 4
Compliance with ARARs	Least likely to achieve groundwater cleanup goals	Would probably not achieve groundwater cleanup goals	Probably best alternative at attempting to meet cleanup goals	Most difficult to achieve action-based ARARs, and similar to Alternative 4 regarding cleanup goals
Short-Term Effectiveness	Effective overall protection, with minimal effectiveness in impacted area	Effective overall protection, with fair to moderate effectiveness in impacted area	Effective overall protection, with good effectiveness in impacted area	Should provide effective protection, although may be adversely impacted by off-site benzene source; overall moderate effectiveness
Long-Term Effectiveness and Permanence	Least effective	Slightly less effective than 4 or 5 (dissolved not actively addressed)	Similar to Alternative 5	Similar to Alternative 4
Reduction of Toxicity, Mobility or Volume through Treatment	Provides least reduction	Reduction may be acceptable, but less than with 4 or 5	Best alternative regarding this criterion	Better than Alternative 3, but mobility and impacts could increase in gas holder area with off-site source
Implementability	Easiest to implement	Readily implementable	Implementable	Most difficult to implement
Cost	Lowest cost	Cost similar to Alternative 4, with higher present worth based on estimated monitoring duration	Cost similar to Alternative 3, with lower present worth based on estimated duration for *in situ* treatment and monitoring	Highest cost
Overall Summary	Unacceptable due primarily to source removal not being included	Less effective than Alternative 4, and *in situ* treatment cost may be offset by reduced monitoring	Best overall alternative	May not be as effective as Alternative 4, with higher cost and more potential adverse impacts

TABLE 10-4

FOCUSED FEASIBILITY STUDY SUMMARY FOR SEDIMENTS

SCE&G Calhoun Park Area Site
Charleston, South Carolina

Criteria	Alternative 1 No Action	Alternative 2 Utilization of Existing Sand Blanket (with Monitoring)	Alternative 3 Removal, Off-Site Thermal Desorption and Backfill (with Perimeter Bldg. Monitoring)
Overall Protection of Human Health and the Environment	○	●	●
Compliance with ARARs	○	●	●
Short-Term Effectiveness	○	◍	○
Long-Term Effectiveness and Permanence	⊗	◍	◍
Reduction of Toxicity, Mobility or Volume through Treatment	⊗	◍	◍
Implementability	●	◍	⊗
Cost	●	○	⊗
Overall Summary	○	◍	○

Legend:
⊗ - low acceptability
○ - fair to moderate acceptability
◍ - moderate to good acceptability
● - high acceptability

1. Rankings are based on limited areas accessible for excavation.

Sufficient information exists for EPA to select a remedy capable of achieving the remedial action objectives for sediments. The remedial goal established for impacted sediments is to address those sediments with ESGTU-HQs that are one or greater for PAHs.

Table 10-4 presents a graphical summary of the overall acceptability of each sediment remedial action alternative regarding the evaluation criteria. The shoreline from Charlotte Street southward to beyond the NPS tour boat facility has been redeveloped. A large area with ESGTU-HQs equal to or greater than one is covered by permanent structures or existing sand blankets and as a result, current ecological exposure has been minimized. Alternative 1 (no action) is unacceptable given the limited monitoring and lack of a future remedial component, if necessary. Alternative 2 (utilization of existing sand blankets, with monitoring) is capable of achieving the remedial objectives, and provides long-term evidence of an intact and effective barrier to sediment exposure. Alternative 3 (excavation, LTTD treatment and backfill, with monitoring) is viable from a technology implementation perspective but, as stated previously, access to formerly impacted areas is extremely limited given the development of the area and only a small area of impact could be removed. Furthermore, the additional cost associated with implementation of Alternative 3, and the potential for release of PAHs through sediment remobilization during removal, are significant concerns. Potential disruptions to tourist activities in the area are anticipated to be minimal, but must also be considered. Alternative 2 is best capable of achieving the remedial objectives established for sediments and has been identified as the most practicable remedy.

12.2 Description of the Selected Remedy

12.2.1 Intermediate Groundwater

Alternative 4 appears to be the best overall remedial action and has been selected to address impacts within the intermediate groundwater zone. Alternative 4 is consistent with the phased approach to groundwater cleanup at the site. This consists of DNAPLs removal to the maximum extent practicable, followed by containment of non-restorable source areas, and restoration of the aqueous plume. The Selected Remedy includes the following components:

- DNAPL removal will be accomplished to the extent practicable.
- In situ treatment of impacted groundwater within the intermediate zone will be conducted.
- Groundwater monitoring will be conducted within the impacted portion of the intermediate zone and at sentinel well locations.
- Restrictions to future uses of intermediate groundwater on SCE&G property at the CPA Site will be imposed.

DNAPL will be removed to the extent practicable using either stationary or portable pumping equipment. A five-year DNAPL recovery period has been projected. The recovered DNAPL will be transported off-site for reuse or treatment and disposal.

Impacted groundwater within the intermediate zone will be addressed using in situ treatment. The type of treatment may involve increasing dissolved oxygen concentrations to stimulate microbial activity and biodegradation, or the direct destruction of dissolved constituents via chemical oxidation. Selection of the most appropriate oxidant will be determined during the remedial design phase, as well as the appropriate areas for injection and the number and anticipated frequency of applications. The selection of oxidant will be based on bench scale testing and field testing results.

Monitoring of the intermediate groundwater zone will be conducted within the impacted portion and at sentinel well locations. Based on the in situ treatment benefits of the Selected Remedy, the total duration of groundwater cleanup period is estimated at five

TABLE 12-1

ALTERNATIVE 4 - INSTITUTIONAL CONTROLS,
DNAPL REMOVAL AND *IN-SITU* TREATMENT
DETAILED COST ESTIMATE

SCE&G Calhoun Park Area Site
Charleston, South Carolina

	Unit	Quantity	Unit Cost	Total
B) Semi-Annual Performance Monitoring				
Analytical Costs	per round	2	$9,700	$19,400
Sampling Labor/Expenses	per round	2	$8,900	$17,800
Reporting	per round	2	$4,900	$9,800
Administration	per round	2	$1,000	$2,000
Subtotal				$49,000
Contingency (approx. 15%)				$8,000
Total Annual Costs (12-year period)				$57,000
C) Annual Sentinel Well Monitoring				
Analytical Costs	per round	1	$6,500	$6,500
Sampling Labor/Expenses	per round	1	$7,500	$7,500
Reporting	per round	1	$4,000	$4,000
Administration	per round	1	$1,000	$1,000
Subtotal				$19,000
Contingency (approx. 15%)				$2,900
Total Annual Costs (12-year period)				$21,900
Total Annual O&M Costs (years 1 thru 3)				**$235,600**
Total Annual O&M Costs (years 4 and 5)				**$173,000**
Total Annual O&M Costs (years 6 thru 12)				**$78,900**
ESTIMATED PRESENT WORTH COST				**$1,319,000**

Notes:

1. Captial cost estimate assumes that all monitoring wells are in place, and that one additional DNAPL recovery well will be required.
2. DNAPL removal cost estimate based on one stationary pumping system currently in place, and purchase of one new stationary system and one new portable system.
3. Present worth cost for *in situ* treatment based on 5% interest rate and six ORC applications total: two applications in year 1 (PWF=1), two in year 2 (PWF=0.9524), and two in year 3 (PWF=0.9070).
4. Present worth cost for DNAPL removal based on 5-year term and 5% interest rate (PWF=4.3295).
5. Present worth cost for performance and sentinel well monitoring based on 12-year term and 5% interest rate (PWF=8.8633).

TABLE 12-2

ALTERNATIVE 2 - UTILIZATION OF EXISTING SAND BLANKET (With Monitoring)
DETAILED COST ESTIMATE

SCE&G Calhoun Park Area Site
Charleston, South Carolina

	Unit	Quantity	Unit Cost	Total
OPERATING AND MAINTENANCE COST FOR EXISTING SAND BLANKET				
A) Augment Sand Blanket at Year 5				
Planning				
Engineering and Design (Sampling and Analytical)	lump sum	1	$10,000	$10,000
Permitting	lump sum	1	$7,500	$7,500
Project Management	lump sum	1	$5,000	$5,000
Subtotal				$22,500
Contingency (approx. 15%)				$3,500
Total Planning				**$26,000**
Field Costs - 50% Replacement				
Mobilization/Demobilization	lump sum	1	$10,000	$10,000
Purchase & Deliver Cover Material (25,000 SF)	cubic yard	925	$8	$7,400
Place Cover Material (Labor and Equipment)	cubic yard	925	$25	$23,125
Geotextile - Installed	square yards	3000	$1.50	$4,500
Silt Curtain - Installed	Linear feet	1100	$3	$3,300
Survey	lump sum	1	$5,000	$5,000
Management and Field Oversight	lump sum	1	$15,000	$15,000
Health and Safety Provisions	lump sum	1	$5,000	$5,000
Subtotal				$73,325
Contingency (approx. 15%)				$10,975
Total Field Costs				**$84,300**
Total for Augmenting Sand Blanket				**$110,300**
B) Supplemental Gravel Cover (Contingency) At Year 5				
Planning				
Engineering and Design (Sampling and Analytical)	lump sum	1	$10,000	$10,000
Permitting	lump sum	1	$7,500	$7,500
Project Management	lump sum	1	$5,000	$5,000
Subtotal				$22,500
Contingency (approx. 15%)				$3,500
Total Planning				**$26,000**
Field Costs - 50% (of area)				
Mobilization/Demobilization	lump sum	1	$10,000	$10,000
Purchase & Deliver Cover Material (25,000 SF)	cubic yard	925	$12	$11,100
Place Cover Material (Labor and Equipment)	cubic yard	925	$25	$23,125
Geotextile - Installed	square yards	3000	$1.50	$4,500
Silt Curtain - Installed	Linear feet	1100	$3	$3,300
Survey	lump sum	1	$5,000	$5,000
Management and Field Oversight	lump sum	1	$15,000	$15,000
Health and Safety Provisions	lump sum	1	$5,000	$5,000
Subtotal				$77,025
Contingency (approx. 15%)				$11,575
Total Field Costs				**$88,600**
Total for Gravel Cover Contingency				**$114,600**
ESTIMATED PRESENT WORTH COST (No Contingencies)				**$292,000**
ESTIMATED PRESENT WORTH COST (All Contingencies)				**$545,000**

Notes:

1. Contingency for sand blanket expansion assumes coverage of an additional 20,000 square foot area (based on ESGTU-HQs >1 with 95% confidence interval). The need to implement this contingency will be determined based on collection of additional data.
2. Operating and maintenance cost estimate assumes replacement of a one foot thickness of cover material over 25,000 square feet (50% of existing and additional sand blanket estimate of 50,000 square feet) at the end of the 5-year monitoring period. The 50,000 square feet estimate of existing sand blanket area is based on areas not covered by buildings and structures.
3. Operation and Maintenance cost estimate provides a contingency to cover 50% of the sand blanket with gravel to prevent excessive erosion, If necessary.
4. Present worth cost is based on a 5-year period and 5% interest rate.

TABLE 12-2 (CONT.)

ALTERNATIVE 2 - UTILIZATION OF EXISTING SAND BLANKET (With Monitoring)
DETAILED COST ESTIMATE

SCE&G Calhoun Park Area Site
Charleston, South Carolina

	Unit	Quantity	Unit Cost	Total
CONTINGENCY FOR SAND BLANKET EXPANSION				
A) Planning				
Engineering and Design (Sampling and Analytical)	lump sum	1	$50,000	$50,000
Permitting	lump sum	1	$10,000	$10,000
Project Management	lump sum	1	$7,500	$5,000
Subtotal				$65,000
Contingency (approx. 15%)				$9,800
Total Planning				**$74,800**
B Field Costs - Additional 20,000 SF Area				
Mobilization/Demobilization	lump sum	1	$10,000	$10,000
Purchase & Deliver cover Material (1-foot thick)	cubic yard	750	$8	$6,000
Place Cover Material (Labor and Equipment)	cubic yard	750	$25	$18,750
Geotextile - Installed	square yards	2500	$1.50	$3,750
Silt Curtain - Installed	Linear feet	1100	$3	$3,300
Survey	lump sum	1	$5,000	$5,000
Management and Field Oversight	lump sum	1	$15,000	$15,000
Health and Safety Provisions	lump sum	1	$5,000	$5,000
Subtotal				$66,800
Contingency (approx. 15%)				$10,100
Total Field Costs				**$76,900**
MONITORING COST				
A) Sand Blanket Monitoring				
Mobilization/Demobilization (year 1 and year 2)	per year	2	$5,000	$10,000
Sampling Labor/Expenses (year 1 and year 2)	per year	2	$10,000	$20,000
Analytical (year 1 and year 2)	per year	2	$2,000	$4,000
Reporting	per year	2	$1,800	$3,600
Administration	per year	2	$700	$1,400
Subtotal				$39,000
Contingency (approx. 15%)				$6,000
Annual Cost (year 1 and 2)				**$45,000**
Mobilization/Demobilization (year 3 - year 5)	per year	1	$5,000	$5,000
Sampling Labor/Expenses (year 3 - year 5)	per year	1	$10,000	$10,000
Analytical (year 3 - year 5)	per year	1	$2,000	$2,000
Reporting	per year	1	$1,800	$1,800
Administration	per year	1	$700	$700
Subtotal				$19,500
Contingency (approx. 15%)				$3,000
Annual Cost (year 3 - year 5)				**$22,500**
B) Building Perimeter Sand Blanket Monitoring				
Mobilization/Demobilization (year 1 and year 2)	per year	2	$0	$0
Sampling Labor/Expenses (year 1 and year 2)	per year	2	$7,000	$14,000
Analytical (year 1 and year 2)	per year	2	$1,400	$2,800
Reporting	per year	2	$700	$1,400
Administration	per year	2	$300	$600
				$18,800
Subtotal				$3,000
Contingency (approx. 15%)				**$21,800**
Annual Cost (year 1 and 2)				
Mobilization/Demobilization (year 3 - year 5)	per year	1	$0	$0
Sampling Labor/Expenses (year 3 - year 5)	per year	1	$7,000	$7,000
Analytical (year 3 - year 5)	per year	1	$1,400	$1,400
Reporting	per year	1	$700	$700
Administration	per year	1	$300	$300
Subtotal				$9,400
Contingency (approx. 15%)				$1,500
Annual Cost (year 3 - year 5)				**$10,900**
Total Annual cost (year 1 and year 2)				**$66,800**
Total Annual cost (year 3 - year 5)				**$33,400**

years with a subsequent monitoring period projected at 12 years.

Future uses of intermediate groundwater for drinking purposes on SCE&G property at the CPA Site will be restricted through a deed notification. Although exposure to intermediate groundwater does not currently exist and is not expected in the future, institutional controls by SCE&G will assure adequate protection of human health.

Alternative 4 is best capable of achieving the remedial objectives established for intermediate groundwater and has been identified as the most practicable remedy. Therefore, the following text describes how Alternative 4 is capable of achieving the site-wide objectives.

Removal or Treatment of DNAPL to the Maximum Extent Practical

Consistent with the phased approach utilized for achieving the shallow groundwater objectives, DNAPL or source removal to the maximum extent practicable is a component of the Selected Remedy. DNAPL monitoring and removal activities will address the removal or treatment of DNAPL within the intermediate zone to the maximum extent practicable. DNAPL recovery efforts within the gas holder and other areas of the site will significantly aid in achieving site-wide groundwater objectives. Therefore, existing site-wide DNAPL recovery activities initiated under operable unit #1 will continue.

Containment of Non-Restorable Source Areas

Completed and any necessary additional DNAPL delineation activities are expected to identify the extent of DNAPL occurrence within the intermediate zone at the site. Available information presented in Section 5.3.3 of this Record of Decision indicates that DNAPL migration within the intermediate zone is not occurring. The planned DNAPL removal activities as described above are expected to adequately address DNAPL within the intermediate zone.

As presently envisioned, aqueous phase containment issues will be addressed by DNAPL removal coupled with in situ treatment. Implementation of this alternative will mitigate the potential migration of dissolved phase constituents. If the in situ measure for source removal adequately mitigates the dissolved phase plume, then the evaluation of additional containment measures for non-restorable source areas would not be necessary.

Restoration of Intermediate Groundwater

Sufficient data currently exist to support selection of the remedy for restoration of intermediate groundwater. Alternative 4 is the best overall remedial action to address impacts within the intermediate zone at the CPA Site. DNAPL will be removed to the extent practicable, and dissolved phase constituents within the intermediate groundwater zone will be addressed. via in situ treatment. Conditions will be monitored to determine the rate and extent of reductions in constituent concentrations over time.

12.2.2 Sediments

Alternative 2 appears to be the best overall remedial action to address sediments. The Selected Remedy includes the following components:

- Monitoring of existing sand blankets at the perimeter of existing structures and along the west bank of the Cooper River will be conducted.

- Maintenance and augmentation of the existing sand blankets will be performed, if required.

The Selected Remedy provides for performance monitoring of the existing sand blankets with contingency plans for maintenance as needed. Additional sampling will also be conducted at selected areas outside the sand blanket to document station-specific PAH and FOC concentrations. Sand blanket monitoring using vibracoring technology is projected to be performed semi-annually for two years, and thereafter performed annually for three years (five years of monitoring total). This schedule coincides with the five- year ROD review timeframe. Although direct measurement of sand blanket integrity underneath the existing buildings is not possible, it is reasonable to conclude that those areas are intact if the sand blankets along the perimeter of the buildings are stable.

During the monitoring, maintenance and augmentation would occur as needed to ensure the ongoing effectiveness of the sand blanket. If results of monitoring suggest that the existing sand blanket is unstable and not effective as a long-term remedy, then replacement or stabilization activities would be undertaken with additional monitoring. Conversely, if natural deposition provides further cover and more permanent sequestration of contaminated sediment, then a reduction or elimination of the monitoring program may be appropriate.

Alternative 2 is best capable of achieving the remedial objectives established for sediments and has been identified as the most practicable remedy. Therefore, the following text describes how Alternative 2 is capable of achieving the site-wide objectives.

Objective 1 – Prevent Exposure of Benthic Organisms to Impacted Sediment
Adequate protection of the benthic organisms will be provided though monitoring and maintenance of the existing sand blankets. Impacted sediment underneath the existing buildings will remain in place, and will be monitored at the perimeter of the buildings for stability.

Objective 2 – Prevent the Volume of Impacted Sediment from Increasing
SCE&G has taken significant steps to remove source material and prevent any further releases of coal tar constituents at the CPA Site. Therefore, this objective is considered achieved prior to implementation of any of the remedial action alternatives for sediment.

Objective 3 – Reduce the Volume of Impacted Sediment
The Selected Remedy ensures the long-term stability of the sand blankets and provides an acceptable ecological risk based on the ERA. However, a reduction in the volume of impacted sediment will not be provided. The Selected Remedy will provide evidence relating to the stability of areas underneath the existing buildings through sand blanket monitoring at the perimeter areas.

Objective 4 – Prevent the Erosion and Provide For Long- Term Stability (Reduce Mobility)
The Selected Remedy prevents erosion and provides for long- term stability by monitoring and maintaining the existing sand blanket.

12.3 Summary of Estimated Remedy Costs

The estimated capital costs for each major remedy component, estimated operation and maintenance (O&M) costs, and total estimated present worth costs are provided in Tables 12-1 and 12-2 for intermediate groundwater and sediments, respectively. More detail regarding the estimated costs and key assumptions utilized in preparing the estimates are provided in the Remedial Investigation/Focused Feasibility Study for the Intermediate Groundwater Zone (MTR, June 2001) and the Focused Feasibility Study For Sediments (MTR, May 2002b). The cost estimates for sediments presented in Table 21-2 were based on the 95 percentile values and differ slightly from the 50 percentile values used to calculate cost persented in the Focused Feasibility Study.

The information in the cost estimate summary tables is based on the best available information regarding the anticipated scope of the remedial alternatives. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design and initial implementation of the remedial alternatives. Significant changes may be documented in the form of a memorandum in the Administrative Record file, an ESD, or a ROD Amendment. These are currently order-of-magnitude engineering cost estimates that are expected to be within +50 to –30 percent of the actual project cost.

12.4 Expected Outcomes of Selected Remedy

Implementation of the Selected Remedy will be protective of the potential land and groundwater uses that are anticipated at the site. The CPA Site and adjacent properties have been developed primarily for commercial use, with a mixture of light industrial, business and residential uses also present. Information provided by government agencies indicates that the CPA Site will continue to be used for commercial purposes. Target clean-up levels for intermediate zone groundwater are identified in Table 8-1, and are based on hypothetical future residential use. Groundwater in the intermediate water-bearing zone has not been used for drinking water purposes in Charleston since the early 1800s, and the potential for human exposure to intermediate groundwater at the CPA Site is minimal. Future redevelopment of the CPA Site and adjacent properties as a residential area with on-site groundwater use is highly unlikely.

Sediments within the Cooper River are currently utilized as a habitat for benthic organisms, and the sediments are expected to continue to be utilized as a habitat in the future. The target clean-up level for PAHs in sediments is a calculated ESGTU-HQ of less than one. The existing sand blankets are believed to provide adequate protection from exposure to sediments exceeding the target clean- up level. Implementation of the Selected Remedy will address the potential ecological risks to benthic organisms through monitoring to confirm the adequacy of the existing sand blankets.

13.0 STATUTORY DETERMINATIONS

Under CERCLA Section 121 and the NCP, EPA must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the Selected Remedy meets these statutory requirements.

13.1 Protection of Human Health and the Environment

The Selected Remedy, Alternative 4 for intermediate groundwater and Alternative 2 for sediments, will protect human health and the environment through media-specific components designed to eliminate or mitigate potential risks posed by the CPA Site. For intermediate groundwater, EPA's remedy consists of DNAPL removal to the extent practicable with recovered DNAPL transported off-site for reuse or treatment and disposal, in situ treatment of impacted groundwater via oxidant addition, groundwater monitoring, and restrictions to future uses of intermediate groundwater on SCE&G property at the CPA Site. For sediments, EPA's remedy consists of monitoring the existing sand blankets at the perimeter of existing structures and along the west bank of the Cooper River, and maintenance and augmentation of the existing sand blankets, if required.

Alternative 4 for intermediate groundwater offers the most protection of human health and the environment, as it actively destroys constituents in situ with no waste products generated. Potential carcinogenic risks associated with exposure to groundwater within the impacted intermediate zone by a hypothetical child or adult resident exceed the EPA target risk range of 10-4 to 10-6 , and the potential noncarcinogenic risks exceed a hazard index of 1.0. However, potential human exposure to impacted groundwater at the CPA Site is minimal, and future redevelopment of the CPA Site and adjacent properties as a residential area with on-site groundwater use is highly unlikely. Therefore, restrictions to future uses of intermediate groundwater on SCE&G property at the CPA Site through a deed notification will assure adequate protection of human health.

The Selected Remedy will minimize the potential for benthic organisms within the Cooper

River to contact impacted sediments, which may be utilized as a habitat. The remedial goal for impacted sediments is to address (via exposure prevention or removal) those sediments with ESGTU-HQs that are one or greater for PAHs. The river shoreline from Charlotte Street southward to beyond the NPS tour boat facility has been redeveloped, and approximately 95 percent of the area with ESGTU-HQs equal to or greater than one is covered by permanent structures or existing sand blankets. As a result, ecological exposure has been minimized and the potential for constituent transport or biological uptake by receptors is considered low.

There are no short-term threats associated with the Selected Remedy that cannot be readily controlled. In addition, no adverse cross-media impacts are expected from the Selected Remedy.

13.2 Compliance with Applicable or Relevant and Appropriate Requirements

The Selected Remedy should comply with all Federal and State ARARs. The chemical, location and action-specific ARARs include, but are not limited to:

- Clean Water Act (40 CFR 230, 320- 330, 403 and 404)
- Coastal Zone Management Act (15 CFR 930)
- DOT Hazardous Materials Regulations (49 CFR 107 and 171-180)
- Federal Fish and Wildlife Coordination Act (16 USC 661)
- Floodplain Management (40 CFR 6)
- OSHA Health and Safety Requirements (29 CFR 1910 and 1926)
- Safe Drinking Water Act (40 CFR 141)
- South Carolina Coastal Management Act (SC Code of Regulations 30-1 through 30-12)
- South Carolina Erosion and Sediment Reduction Act (SC Code of Regulations 72-300)
- South Carolina Pollution Control Act (SC Code of Regulations 61-68 and 61-69)

In selecting the remedy, EPA and the State have considered a number of non-binding criteria, referred to as To Be Considered (TBCs), including Ecological Screening Values for Sediment (EPA Region IV Ecological Risk Assessment Bulletins - Supplement to RAGS) and Equilibrium Partitioning Sediment Guidelines for the Protection of Benthic Organisms: PAH Mixtures (EPA Final Draft dated April 5, 2000).

Because uncertainty exists regarding the ability of any remedy to achieve the groundwater target clean-up goals due to the presence of residual DNAPL in the intermediate zone, a phased approach has been selected for implementation.

13.3 Cost-Effectiveness

The Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness” (NCP Section 300.430(f)(1)(ii)(D)). This was accomplished by evaluating the "overall effectiveness" of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness. The relationship of the overall effectiveness of the selected remedial alternative for intermediate groundwater and sediments was determined to be proportional to its costs and hence the selected alternatives represent a reasonable value for the money spent.

The estimated present worth cost of the Selected Remedy is $1,319,000 for intermediate groundwater (Alternative 4) and $292,00 for sediments (Alternative 2). Although Alternative 1 for intermediate groundwater (limited monitoring) and Alternative 1 for sediments (no further action) are less expensive, those alternatives are not adequately protective of human health and the environment. The Selected Remedy's additional cost for DNAPL recovery, in situ treatment, groundwater monitoring, institutional controls, and sediment sand blanket monitoring and maintenance provides a significant increase in protection of human health and the environment and is the most cost-effective overall remedy. The Selected Remedy will provide an overall level of protection comparable to the combination of Alternative 5 for intermediate groundwater (similar to Alternative 4, with groundwater extraction rather than in situ treatment) and Alternative 3 for sediments (excavation and off-site treatment of accessible impacted sediments, with backfill and monitoring) at a significantly lower cost.

13.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable (MEP)

The Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the site. Of those alternatives that are protective of human health and the environment and should comply with ARARs, EPA has determined that the Selected Remedy provides the best balance of trade- offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and bias against off-site disposal of untreated wastes and considering state and community acceptance.

The Selected Remedy treats the source material (DNAPL) constituting the principal threat within OU# 2 by removing the quantity of free-phase DNAPL to the extent practicable from the intermediate zone, and transporting the DNAPL off-site for reuse or treatment and disposal. Dissolved phase constituents within the intermediate zone are also addressed via in situ treatment. PAH constituents in sediments have been identified as of concern, due to potential exposure to benthic organisms. However, based on the limited extent of sediments impacted by PAHs, the presence of the existing sand blankets, and the calculated potential ecological risks, impacted sediments are considered a low-level threat and exposure control via the sand blankets provides adequate protection.

The Selected Remedy adequately satisfies the criteria for long-term effectiveness and permanence through a combination of treatment and controls. The DNAPL removal and in situ treatment components of the selected alternative for intermediate groundwater provide an adequate overall reduction in the toxicity, mobility and volume of constituents. The selected alternative for sediments does not involve a direct reduction in the toxicity or volume of impacted sediments. Potential mobility is addressed through monitoring and augmentation, if needed, of the sand blankets. None of the intermediate groundwater or sediment alternatives appear to have the potential for significant adverse short- term effects on the community or remediation workers. The short-term effectiveness of any intermediate groundwater alternative in addressing dissolved phase constituents depends upon the amount of residual DNAPL. The selected sediment alternative (Alternative 2) is more reliable than Alternative 1 (no action) because the sand blankets would be monitored and augmented if necessary. Sediment Alternative 3 involves the potential suspension and redeposition of sediments during excavation, which may cause adverse environmental impacts.

The intermediate groundwater alternatives are all considered readily implementable, although Alternative 5 (which involves groundwater extraction and discharge) would require permitting and O&M which may result in some administrative constraints. The selected sediment alternative is readily implementable. Sediment Alternative 1 (no remedial action or monitoring) would be the easiest to implement. Sediment Alternative 3 is considered implementable at this time, although it involves additional administrative requirements and the overall implementability is severely limited by access constraints.

13.5 Preference for Treatment as a Principal Element

The Selected Remedy addresses the principal threat posed by OU# 2 through the use of treatment technologies to the extent practicable. DNAPL within the intermediate groundwater zone constitutes the principal threat within OU# 2. The principal threat (DNAPL) is most appropriately addressed via removal to the extent practicable. Dissolved phase constituents within the intermediate groundwater zone will be addressed via in situ treatment. PAH constituents in sediments have been identified as of concern, due to potential exposure to benthic organisms. However, impacted sediments are considered a low-level threat and exposure control via the sand blankets provides adequate protection. By utilizing treatment to the extent practicable, the statutory preference for remedies that employ treatment as a principal element is adequately addressed.

13.6 Five-Year Review Requirements

Because this remedy will result in hazardous constituents remaining on-site above levels that allow unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action, and every five years thereafter until such time that groundwater remediation goals have been achieved. The need for future Five Year reviews will be determined at that time.

14.0 DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for the Calhoun Park site was released for public comment in July 2002, and identified Alternative 4 (institutional controls, DNAPL removal and In Situ treatment) as the preferred alternative for groundwater and Alternative 2 (utilization of existing sand blanket with monitoring and maintenance) as the preferred alternative for sediments. EPA reviewed all written and verbal comments submitted during the public comment period . It was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate.

15.0 REFERENCES

Black & Veatch, October 1994. Baseline Risk Assessment for the Calhoun Park Area Site, Charleston, South Carolina. Prepared for USEPA Region IV by Black & Veatch Waste Science, Inc. under EPA Work Assignment No. 15, dated October 24, 1994.

Chester Environmental, September 1993. Remedial Investigation and Feasibility Study Work Plan, Calhoun Park Area Site, Charleston, South Carolina.

City, July 1996. City of Charleston letter to Walter Irwin of SCE& G regarding plans for development of Calhoun Park, dated July 23, 1996.

Edwards, L.E., L.M. Bybell, G.S. Gohn and N.O. Frederiksen, 1997. Paleontology and Physical Stratigraphy of the USGS - Pregnall No. 1 Core (DOR-208), Dorchester County, South Carolina. U. S. Geological Survey Open-File Report 97-145.

EPA, August 1997. Rules of Thumb for Superfund Remedy Selection, Office of Solid Waste and Emergency Response. EPA-540-R-97-013.

EPA, April 1998. EPA's Contaminated Sediment Management Strategy, Office of Water, Washington, D. C. EPA-823-R-98-001.

EPA, September 1998. Enforcement Record of Decision, Remedial Alternative Selection, Calhoun Park Superfund Site, Charleston, Charleston County, South Carolina. Prepared by U. S. EPA Region IV, Atlanta, Georgia, issued on September 30, 1998.

EPA, December 1998. Guidance for In Situ Subaqueous Capping of Contaminated Sediments, Great Lakes National Program Office, Chicago, IL. EPA-905-B96-004.

EPA, July 1999. A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents, Office of Solid Waste and Emergency Response. EPA-540-R-98-031.

Fluor Daniel GTI, September 1996. Final Remedial Investigation Report, Calhoun Park Area Site, Charleston, South Carolina.

Fluor Daniel GTI, October 1997. Draft RI Addendum Report – Additional Sediment Sampling, Calhoun Park Area Site, Charleston, South Carolina.

Fluor Daniel GTI, November 1997. Feasibility Study, Calhoun Park Area Site, Charleston, South Carolina.

Godfrey and Associates, February 2000. Interim Report on Additional Sediment and Surface-Water Characterization, Calhoun Park Area Site, Charleston, South Carolina.

Godfrey and Associates, April 2002. Interim Report on Ecological Risk Assessment (ERA) Process Step 3: Problem Formulation, Sediment and Surface-Water Characterization, Calhoun Park Area Site, Charleston, South Carolina.

HUD, August 1996. U. S. Department of Housing and Urban Development letter to Walter Irwin of SCE&G regarding future use of Ansonborough Homes Site in Charleston, South Carolina, dated August 21, 1996.

Krause, R.E. and R.B. Randolph, 1989. Hydrology of the Floridian Aquifer System in Southeast Georgia and Adjacent Parts of Florida and South Carolina. USGS Professional Paper 1403-D.

MTR, June 2001. Remedial Investigation/Focused Feasibility Study Report for the Intermediate Groundwater Zone, Calhoun Park Area Site, Charleston, South Carolina.

MTR, February 2002. Intermediate Groundwater Interim Status Report, Calhoun Park Area Site, South Carolina Electric & Gas Company, Charleston, South Carolina.

MTR, May 2002a. Modification of Groundwater Clean-Up Goals, Calhoun Park Area Site, Charleston, South Carolina.

MTR, May 2002b. Focused Feasibility Study for Sediments, Calhoun Park Area Site, South Carolina Electric & Gas Company, Charleston, South Carolina.

APPENDIX A
State Concurrence Letter

FROM SCDHEC EQC LAND/WASTE MANAGEMENT
PROMOTE PROTECT PROSPER
2600 Bull Street
Columbia, SC 29201-1708

September 23, 2002

Jimmy Palmer
Regional Administrator
U.S. EPA, Region IV
Atlanta Federal Center
61 Forsyth Street, SW
Atlanta, Georgia 30303

Re: Calhoun Park Area Site – Operable Unit 2
Charleston, South Carolina
Final Record of Decision

Dear Mr. Palmer :

The Department has reviewed and concurs with all parts of the Record of Decision (ROD) dated September 2002 for the Calhoun Park Area Site – Operable Unit 2 located in Charleston, South Carolina. In concurring with this ROD, the South Carolina Department of Health and Environmental Control (SCDHEC) does not waive any right or authority it may have under federal or state law. SCDHEC reserves any right or authority it may have to require corrective action in accordance with the South Carolina Pollution Control Act. These rights include, but are not limited to, the right to insure that all necessary permits are obtained, all clean-up goals and remedial criteria are met, and to take separate action in the event clean-up goals and remedial criteria are not met. Nothing in the concurrence shall preclude SCDHEC from exercising any additional administrative, legal, and equitable remedies available to the Department that require additional response actions in the event that: (1)(a) previously unknown or undetected conditions arise at the site or (b) SCDHEC receives information not previously available concerning the premises upon which SCDHEC relied in concurring with the selected alternative; and (2) the implementation of the remedial alternative selected in the ROD is no longer protective human health or the environment.

The Department concurs with the selected alternative of DNAPL Removal for the continued non-aqueous material remaining on site using stationary or portable pumping equipment. In addition, the Department concurs with the selected remedy of the intermediate groundwater zone of in situ treatment. The in situ treatment will involve increasing dissolved oxygen concentrations to stimulate biodegradation or direct distruction of dissolve constituents via chemical oxidation. It is our understanding that the specific oxidant or reductant and number and frequency of applications will be determined during the remedial design phase. All work on the aqueous and non-aqueous portions of the groundwater plume will continue to be monitored with a system of performance monitoring wells.

The Department concurs with the selected alternative for sediments at the site that will include monitoring of the existing sand blanket on the west bank of the Cooper River and maintenance of that blanket if required. It is our understanding that the sand blanket may be augmented depending on supplemental data collected during the remedial design phase and future degradation of the blanket in the future.

If you should have any questions regarding the Department's concurrence with the ROD, please contact Scott Wilson at (803) 896-4077.

Sincerely,

R. Lewis Shaw

R. Lewis Shaw
Deputy Commissioner
Environmental Quality Control

cc : Hartsill Truesdale, BLWM
Keith Lindler, BLWM
Richard Haynes, BLWM
Scott Wilson, BLWM
Kent Coleman, BLWM
Rick Richter, Trident EQC
54475; file

APPENDIX B
Risk Assessment Summary Operable Unit #1

health and the environment.

Surface water samples were collected from flood water surrounding Ansonborough Homes, Cooper River surface waters, and three storm water outfalls. BTEX, SVOCs, and PAHs were detected at the point where the Calhoun Street drain outfall enters the Cooper River (SW-10). Additionally dioxins were detected in surface water samples collected from the Cooper River and the Calhoun Street drain. These results were compared to U. S. EPA acute and chronic Ambient Water Quality Criteria (AWQC). While surface water contamination was present in surface waters surrounding the site, the concentrations of these contaminants did not exceed the AWQC standards. These same contaminants were also present in low levels throughout the study area, including some of the background locations. While there was no significant threat from surface water contamination to humans from this site at the close of RI, the recent release of contamination via seeps will require additional investigation as mentioned in the preceding paragraph.

6.0 SUMMARY OF SITE RISKS

The human health baseline risk assessment process provides the basis for taking action and identifies contaminants and the exposure pathways that need to be addressed by the remedial action. It estimates what risks the site poses if no action were taken. This section of the ROD summarizes the results of the human health baseline risk assessment for this site. Environmental risks are presently unresolved due to the on- going discharge of coal tar from seeps as discussed in section 4. The environmental risks resulting from these seeps, in addition to the overall environmental risk associated with this Site, will be evaluated under operable unit two and addressed in a second ROD for this site.

The evaluation of human health risk associated with this site is discussed within three documents present in the Administrative Record: the Baseline Risk Assessment by Black & Veatch, the Revision to Risk Assessment written by EPA, and the Assessment of Risk for NPS which was also written by EPA. Typically the site risk is presented under one document and titled as the Baseline Risk Assessment. A discussion as to why these three documents are pertinent in assessing site risk is offered in the following paragraphs.

Initially the baseline risk assessment document was submitted to EPA in a draft format on August 1994 with a revision submitted on October 1994 which was accepted as a final version. EPA then discovered several errors which remained in this document. To address these errors EPA generated the Revision to Risk Assessment dated July 1996. Meanwhile the Killam Report and the PSI Report were generated. Following a review of these two data sets, EPA initially decided to evaluate the data separate from the RI data, and present the results in the document titled "Assessment of Risk at the National Park Service Property, December 11, 1995.” This decision was based on two considerations: the highly skewed sample locations, and that these soils would be removed during the aquarium construction. The same exposed populations were examined, i.e., current trespassers, future construction workers, and future residents, for contaminated soils. In general the contaminant levels, specifically inorganics, PAHs and PCBs were found in higher concentrations in the ESI/Killam reports than in the RI.

During the Feasibility Study EPA expanded this risk assessment strategy and required that all future calculations for Preliminary Remediation Goals (PRGs) evaluate information within all three data sets. Asa result the Administrative Record actually contains three sets of PRGs: those in the revised BRA, the Assessment of Risk at the National Park Service Property, and those found in the FS. The PRGs present in the FS are the most representative of the general site conditions and are therefore maintained throughout this ROD. The following discussion provides a generic outline for the processes used in all three documents.

6.1 Human Health Baseline Risk Assessment

The human health risk assessment process consists of the following major components: exposure assessment, toxicity assessment, and risk characterization. The exposure assessment involves the identification of potentially exposed populations and pathways, calculation of media-specific exposure point concentrations from data generated during the RI, and development of assumptions regarding exposure frequency and duration. The toxicity assessment utilizes existing chemical-specific toxicity information to determine the types of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure and adverse effects. Carcinogenic risks are evaluated by factoring the intake of a chemical with the slope factor for that contaminant. Non-carcinogenic risks are evaluated by comparing the intake of a chemical to the corresponding reference dose of that compound. Risk characterization combines the exposure and toxicity assessments to quantitatively and qualitatively evaluate the potential risks posed. The risk assessment process concludes by the calculation of media-specific cleanup levels that are adequately protective of human health. Cleanup levels are discussed further in Section 7.1 below.

EPA employed a reasonable maximum exposure (RME) approach to estimate the potential exposures and associated risks at the site. The RME is the highest exposure that is reasonably expected to occur at the site and is intended to estimate a conservative exposure case that is still within the range of possible exposures. The exposure pathways evaluated in this assessment included incidental ingestion and dermal contact with surface/subsurface soils, sediments, and groundwater ingestion and inhalation.

EPA evaluated the chemicals detected on-site according to their potential to produce either cancer and/or non-cancer health effects. The carcinogenic risk range EPA has set for Superfund cleanups to be protective of human health is 1 x 10-4 to 1 x 10-6. For example, a cancer risk of 1 x 10-6 indicates that an individual has a 1 in 1,000,000 (or 1 in 10,000 for 1 x 10-4) incremental chance of developing cancer as a result of site-related exposure to a carcinogen over a 70 year lifetime under the specific exposure conditions at the site. EPA generally uses the cumulative benchmark risk level of 1 x 10-4 for all exposures relating to a particular medium to trigger action for that medium. In other words, a carcinogenic risk greater than 1 x 10 -4 for soil would indicate that remedial action for soil is necessary. However, EPA may decide that a risk level less than 10-6 (i.e., a risk between 10-4 and 10-6) is unacceptable due to site- specific conditions and that remedial action is warranted.

Non- cancer exposure estimates were developed using EPA reference doses to calculate a Hazard Index (HI). A HI greater that 1 indicates that constituents are present at concentrations that may produce harmful effects. The resultant carcinogenic and non-carcinogenic risks for the future on-site construction worker, future on- site worker and future on-site resident are provided in Table 6-1.

The principle threat to human health and the environment at this Site is from exposure to contaminated soils and groundwater. This is illustrated by the conceptual site model which traces NAPLs migrating from MGP source areas through unsaturated soils and downward to the groundwater. The migration of NAPLs would continue through the saturated zone until encountering zones of lower permeability. This would result in exposure pathways consisting of contaminated soils in the unsaturated and saturated zones, a dissolved phase groundwater plume, and NAPL source areas.

Potentially exposed populations to these pathways could include both commercial workers and residential populations. Commercial workers are most likely to be exposed to contaminated surface and subsurface soils whereas future residential populations would likely be exposed to contaminated surface soils and groundwater. It should be noted that while both commercial and residential scenarios were evaluated the most likely use of the property is commercial.

The evaluation of the commercial workers and future residential populations within these exposure scenarios resulted in unacceptable risk levels from soils and groundwater. As evidenced in Table 1, risks under the construction worker and long term worker scenarios were largely driven by incidental ingestion and/or dermal contact with surface and subsurface soils. The risk to future resident scenario was driven primarily by exposure to groundwater. As footnoted in table one, the total risk values were calculated separately regarding the shallow aquifer and the deep aquifer as it is not expected that a given child would be exposed to both aquifers. The contaminants which contribute significantly to the site risks are PAHs and arsenic.

For this Site, EPA believes that remedial action is warranted based on site- specific conditions discussed above. The following sections evaluates the remedial alternatives considered for this Site and their effectiveness in addressing these principal threats.

TABLE 6-1 LIFETIME CARCINOGENIC AND NON-CARCINOGENIC RISKS INDUSTRIAL AND RESIDENTIAL SCENARIOS						
Exposure Pathway	Construction Worker		On-Site Long Term Worker		Future Resident (Child)	
	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index[1]
Surface Soil						
Incidental Ingestion	$4.0e^{-6}$	$1.1e^{-1}$	$1.0e^{-5}$	$5.2e^{-2}$	$6.2e^{-5}$	$1.4e^{+0}$
Dermal Contact	5.8^{-7}	7.4^{-3}	$4.9e^{-6}$	$2.3e^{-2}$	$8.9e^{-6}$	$9.4e^{-2}$
Subsurface Soil						
Incidental Ingestion	$7.8e^{-6}$	$3.9e^{-3}$	NE	NE	NE	NE
Dermal Contact	$1.9e^{-6}$	$4.8e^{-4}$	NE	NE	NE	NE
Shallow Groundwater						
Ingestion/ Inhalation	NE	NE	NE	NE	$1.4e^{-3}$	2.3^{+2}
Deep Groundwater						
Ingestion/ Inhalation	NE	NE	NE	NE	$5.0e^{-3}$	$6.7e^{+3}$
Total Risk	$2.4e^{-5}$	0.12	1.5^{-5}	0.075	$5.0e^{-3}$ *	6700*

Footnotes:
*Total risk values from exposure to deep groundwater. The total risk from the shallow groundwater calculated at $1.4e^{-3}$ (carcinogenic) and 230 (non-carcinogenic).
NE - Not evaluated for this receptor.

APPENDIX C
RESPONSIVENESS SUMMARY

RESPONSIVENESS SUMMARY

The following section addresses comments received during the public comment period which began on July 8, 2002 and ended on August 8, 2002. Comments were received from the City of Charleston, the South Carolina Department of Natural Resources, and the National Oceanic and Atmospheric Administration. All comments are presented in italics and are followed by EPA response in regular script.

1. What kind of property restrictions do you envision and what is the likelihood that they will ever be lifted or reduced? Which properties will be affected by the restrictions?

The most likely example would be a deed restriction on any type of subsurface activity (construction, drinking well installation, etc.) while the cleanup is underway. Permanent deed restrictions may be needed restricting future groundwater usage, depending upon the extent of unrecoverable DNAPL remaining at the site. Permanent deed restriction will likely be limited to the area within the electrical substation. If the City of Charleston has specific concerns about potential property restrictions negatively impacting development on or around the site, EPA will take any reasonable steps to see that our cleanup actions do not hinder area development.

2. If Option 3 is approved and chemical oxidants are injected into the deep aquifer where will the injection points be located? Can you use existing monitoring wells?

The location of the injection points will generally be within the electrical substation. A limited number of injection points may be located across Washington Street and possibly Concord Street. The existing monitoring wells can be used for injection purposes, but doing so would compromise that particular well for future monitoring purposes. The use of direct push technologies, which leaves no temporary nor permanent structures in place, is a better application method for this site.

3. If the cleanup operations extend onto the Aquarium sight, will the city have the opportunity to comment on and approve the method and location? Will there be equipment used that could potentially damage the physical improvements on the Aquarium site, Liberty Park or the National Park Service Tour Boat site?

If access to adjacent properties is needed, EPA will seek access agreements for these properties and coordinate the activities to ensure that every reasonable measure is taken to minimize the impact to operations on these properties. Any physical improvements impacted by the cleanup process would be restored to their original condition.

3. What will be the future concerns for this site when this work is complete?

Once the work is completed, the primary long term concern will be over monitoring the stability of the sediments. Monitoring of the sediments will be addressed during the Operations and Maintenance activities, within the initial Five Year review, and subsequent Five Year reviews depending upon the results of the first Five Year review. Regarding groundwater, there may be small areas where coal tar remain, or dissolved phase plume is present, that would not justify additional cleanup yet monitoring would be appropriate for these areas as well.

4. The “additional sediment stabilization measures" need to be outlined within the sediment cleanup option #2 (utilize existing sand cap) and the cost estimate revised accordingly. This will provide a more realistic portrayal of what will be necessary if the current sand cap is found to be unreliable.

Additional stabilization measures, if needed, would result in cost greater that the cost of items listed (i.e. additional sand placement). Therefore the sediment cleanup option #2 has been revised to include information on stabilization measures, and the cost estimate changed to reflect these measures.

5. The monitoring cost estimate for sediment cleanup option #2 extended over a five year period, yet the proposed plan conclusion states that "long term monitoring will occur to ensure the effectiveness of the remedy". We believe a more accurate cost estimate would include more than only five years of monitoring, in order to reflect the "long term" time period.

A five year monitoring period would be sufficient to detect any early signs of sand blanket erosion. Sampling performed in 1997 did indicate that the sand blanket, which was installed in 1995, still exists beneath the aquarium footprint. While this is not conclusive evidence that the sand blanket is stable across the entire site, the data does suggest that the sand blanket did remain in place within this crucial area over a two year period.

EPA's intent was to select a monitoring period adequate for documenting any erosion patterns or sediment redeposition which could indicate eventual problems with the sand blanket. The selection of a five year monitoring period was based on the premise that any erosion which will occur at this site should be observable during this time frame. Because there may be some conditions that would justify additional monitoring events (e.g. storm event), the Performance Standards Verification Plan will include contingency monitoring to evaluate the integrity of the sand blanket after such events.

6. The evidence, as presented in the Problem Formulation document, does not support the statement on page 2 of the Proposed Plan that the sand cap installed as a temporary protective measure during construction of the aquarium and tour boat facility "presently exists over the majority of the contaminated sediments" (see comment #3 in the attached letter). We recommend that the language in the Proposed Plan be modified accordingly.

The sand blanket should not have been described as "existing over the majority of the contaminated sediments". While the evidence supporting the presence of the sand blanket is compelling, the sampling was limited in regards to the number of stations evaluated. Section 2.4.2.1 of the Problem Formulation document did show that the sand blanket was present in substantial amounts in the three samples taken within the sand blanket footprint (SD-5, SD-6, and SD-8). Section 2.4.1.1 of the Problem Formulation document also record the presence of sand at the Charlotte Street seep area (S-1, S-2, S-3, S-4, S-6, and S-8). Rather than revise the existing proposed plan, EPA will use language in the Record of Decision that qualifies the known condition of the sand blanket. The remedial design will include a more exhaustive sampling plan to evaluate the integrity of the sand blanket.

7. A single monitoring event at the end of the 5-year review period is inadequate to determine either the short-term or long-term stability of the existing sand blanket, or the adequacy of this remedy in isolating the contaminated sediments. The SCDNR recommends that, at a minimum, a detailed monitoring and contingency plan be developed during the Remedial Design Phase of this project, and that the Natural Resource Trustees be consulted on the details of this plan during its development.

Sampling performed beneath the aquarium two years after placement of the sand blanket indicated the presence of the original sand blanket. A future five year monitoring period should provide an adequate time frame for documenting any erosion patterns. Any erosion which may occur at this site should be observable during this time frame. The Remedial Design and the Performance Standards Verification Plan will detail the sediments monitoring steps in addition to the requirements for implementing the contingency plan for sediment stabilization. EPA will also solicit comments from the Natural Resource Trustees during development of the remedial design.

8. Description of the plumes under "Results of the Investigation" requires some clarification. Are the dissolved and DNAPL plumes moving, stable or we don't know? The text repeatedly describes the plume(s) as "deep". Yet the depth is 30 to 80 feet BLS. Is this considered "deep"? Wells describe in Figure 1 suggest the plumes are in the "intermediate" aquifer.

Given that this source has been in place for some time between 50 and 150 years, the extent of the plume migration is relatively small. Therefore the groundwater plume can be considered to be relatively stable. The plume was described as "deep" in order to differentiate the groundwater contamination discussed in this Proposed Plan for Operable Unit 2 from the "shallow plume" addressed in the original Record of Decision. For clarification purposes, all of the groundwater discussed within the Proposed Plan and the Record of Decision for Operable Unit 2 address the zone of groundwater which lies below the shallow aquifer and above the Cooper Marl.

9. Sole reliance on the ESGTU-95 HQs (Figure 1-4) is inconsistent with the FS report which focused on the ESGTU-50 (assuming 8.5% organic carbon).

The FS should have presented cost values for both the 95% and 50% confidence interval. Ultimately the values for the 95% confidence values were calculated and utilized in the ROD. In the absence of site specific toxicity testing, EPA has chosen to default to the more protective risk range represented by the 95% confidence interval, rather than the 50% confidence interval. The resulting cost increase can be seen in Alternatives 2 and 3. The significant change is reflected in the extent of sediments of concern which lie outside the original sand blanket "footprint", as a result of utilizing the 95% confidence interval.

10. The statement on page 4 suggesting there are "limited technologies available for sediment cleanup" ignores the wide array of equipment, technologies and experience that have been developed for the cleanup of contaminated sediments.

EPA's approach for addressing contaminated sediments primarily consists of monitored natural attenuation, capping, or dredging. The use of treatment technologies (chemical, biological, or solidification) are still in the early stages. Experiences gained to date have indicated that technical limitations to the effectiveness of available in- situ treatments continue to exist. For example, in-situ remedies relying on the addition of required substrates have been developed for some contaminants, such as polychlorinated biphenyls (PCBs), but no effective in-situ delivery system has been developed to deliver the needed reagents to contaminated sediment.

11. The No Action alternative shows a cost of $22,500 and includes "environmental monitoring". No action should mean no action. Monitoring should be included in Sediment Options 2 and 3. The No Action alternative described in this Proposed Plan is inconsistent with the FS report, which shows no activity, no monitoring, and $0 costs.

The environmental monitoring costs of $22,500 listed under the No Action alternative reflects the cost of performing a Five Year review at this site. The NCP 40 CFR §300.430(f)(4)(ii) requires that Five Year reviews be performed on all sites where hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

12. Why is the duration for sediment monitoring so much shorter (5 years) than that for ground water (20-50 years)? At a minimum, provisions should be made to monitor sediments after high energy events in the Charleston area such as storms and hurricanes.

The difference in the duration of monitoring times between the sediments and groundwater is related to the difference in cleanup objectives for each media. For the sediments, the duration of the monitoring event need only to assess the stability or instability of the sediments. The Operations & Maintenance Plan will include previsions for monitoring the sediments after high energy events, regardless of the time period in which they occur.

13. Sediment Option 3 indicates sediments outside the footprint of the aquarium and NPS facility will be excavated. This is inconsistent with Figure 1-4 of the Feasibility Study which indicates only a small volume of sediments around the NPS facility will be removed. A figure showing areas to be excavated under Sediment Option 3 should be included in the Proposed Plan.

The referenced figure within the FS was based on the 50 percentile values. However, the ROD will utilize the 95 percentile values and include a figure showing the excavation area based on this confidence interval.

14. Reword last sentence to read "Option #3 would also act to reduce the toxicity, mobility and volume of contaminated sediments through excavation and placement in a landfill.”

While excavation and placement of contaminated sediments in a landfill would reduce the mobility of contaminated material, the material would still retain its toxicity and volume.

15. The proposed remedy represents a change in the technical approach, moving from the 50 percentile to the 95 percentile.

EPA has maintained a consistent interest in both intervals as evidenced in our Agency's request for inclusion of the figures and tables, illustrating the 95 percentile values for calculating Hazard Quotients (HQs), in the Ecological Risk Assessment. The significance of using the 95 percentile over the 50 percentile in calculating the HQ values becomes more apparent in consideration as to how the information was utilized at this site. EPA views the development of HQs as a method for identifying the general locations of sediments of concern. They do not definitively answer the risk questions (i.e. would the site sediments cause adverse effects to benthic organisms?). Typically the sediments of concern are further refined during the risk assessment through toxicity testing, a process which would answer the question about whether the sediments are causing adverse effects to benthic organisms. For this site, EPA agreed to move from the development of HQs to the risk management step, effectively streamlining the process through bypassing the toxicity testing, provided that a reasonably conservative model was used in calculating the HQs. The use of a 50 percentile versus the 95 percentile effectively doubles the uncertainty associated with the model and would not be viewed a conservative approach for modeling the ecological risk.

16. The 50 percentile ESGTU-HQs agree closely with the TEC-HQs, and would be appropriate for use at this site.

The agreement would occur only when using proxy values of 8.5% for Total Organic Carbon (Toc). In contrast, replacing these values with 3.4% (by proxy) show a close correlation between the 95 percentile ESGTU-HQs and the TEC-HQs. Ultimately the use of proxy values adds another level of uncertainty to the risk assessment model.

17. The proposed remedy deviates from the agreed upon benchmark, using draft ESGTU guidance that has not been finalized and published in the Federal Register.

While we have agree upon the use of a benchmark, our disagreement is over the input values for calculating that benchmark, more specifically the calculation of Hqs. Ultimately our intent was to find a practical way to streamline the ecological risk assessment process at this site. The use of the 95% percentile ESGTU-HQ, based on station specific Toc and PAH values, would be viewed as a reasonably conservative approach supporting a streamlined risk assessment approach for this site. This data could be readily collected as part of the remedial design, with station specific Toc and PAH values collected to resolve the uncertainty associated with the use of proxy values. The resulting data could be used to calculate specific ESGTU-HQs. The HQs could be used to determine the extent of the sediments of concern, and the extent of the sand blanket revised as needed to address these areas. If the data show ESGTU-HQ values disproportionate to the current data, we could discontinue the streamlined approach a pursue toxicity testing to definitively identify sediments requiring remedial actions.